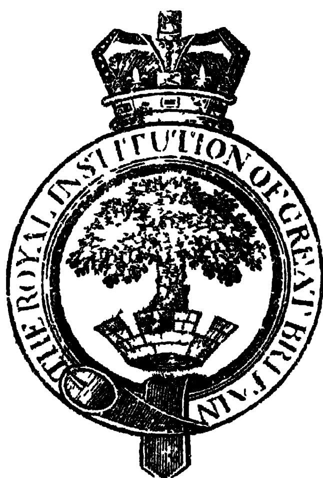
THE

QUARTERLY JOURNAL

OF

SCIENCE,

LITERATURE, AND ART.



JANUARY TO JUNE, 1828

LONDON:

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MDCCCXXVIII.

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TO OUR READERS AND CORRESPONDETNS.

We have received two letters upon the subject of the Thames Tunnel: that signed "A Shareholder," is anticipated as to its contents by a *Letter* which has been published. The other, from "A Contributor to the Subscription," we recommend for the newspapers.

We cannot, at present, enter upon the subject of London Bridge and Thames-street; but believe that the apprehensions entertained by "An admirer of Sir Christopher Wren" are quite groundless.

A. B., on the Influence of Knowledge, &c., is not quite suited to this Journal

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As very partial and often garbled extracts from the Report upon the Supply of Water to the Metropolis, have hitherto only appeared in the newspapers, we have thought it right to publish the whole of that document.

We have again been obliged, in consequence of the pressure of other matter, to postpone the greater portion of Reviews of Books. the subject shall be attended to in our next Number. Several original communications and others have, for the same reason, been deferred.

Dr. Harwood's paper on the Whale tribe, being the substance of his discourse upon that subject referred to in the Proceedings of the Royal Institution, will be printed in our next Number: we much regret having

been obliged to omit it in its proper place. We have also been under the necessity of postponing an interesting Communication from Captain Sabine, upon the Steam Boats of the United States.

As we have declined the insertion of some communications upon the subject of the London University, we also think it right, for the present at least, to withhold the letter signed "Verulam," upon the subject of the new King's College.

TO OUR READERS AND CORRESPONDENTS.

THE drawings, illustrating the construction of a Blow-pipe, are not sufficiently accurate to enable us to publish them. Our Correspondent will observe that we have noticed another part of his letter.

We regret that we are unable to offer our Correspondent, upon the subject of *Gas Works*, any precise information. There can be no doubt that an atmosphere tainted by coal gas is injurious to animal and vegetable life, but much will depend upon the extent of the contamination, and other causes, of which our limits prevent mention. To say nothing of danger from fire and from explosion, it has always been matter of surprise to us that gas-works are tolerated by the government in close and confined situations—that the Thames is suffered still to be polluted with their offal, and that they are sometimes placed close by the road side, (as at Brentford,) to the nuisance of every one who passes. These matters want looking into.

Q. will find an answer to his question, in the "Gazette of Health" for last July.

F. R. S. must remain unanswered till after St. Andrew's Day.

Dr. Heinecken's paper is disposed of as he desired.

Mr. Brande and Mr. Faraday will commence their Lectures and Demonstrations in Theoretical and Practical Chemistry, in the Laboratory of the Royal Institution, *on Tuesday, the 9th of October*, at Nine in the Morning precisely. Further particulars, and a Prospectus, may be obtained at the Royal Institution, 21, Albemarle-street, or by application to the Lecturers.

In the Press—A Collection of Chemical Tables, for the use of Students, in Illustration of the Theory of Definite Proportionals, in which are shewn the Equivalent Numbers of the Elementary Substances, with the Weights and Volumes in which they combine, together with the Composition of their most important Compounds, and the Authorities for their Analysis. By William Thomas Brande.

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THE

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On the Inland Navigation of the United States of America.

PART I.

(Communicated by the Author.)

It is now some time since the United States of America have ranked as a maritime nation, second to Great Britain alone. It is, however, only recently that the public attention has been turned, in that country, to the improvement of internal navigation; but such rapid progress has been made in that direction, within the last ten years, that, in this respect also, it may be considered as having surpassed any other nation except England: nay, such is the demand for inland water communication, arising from the wide spread of an agricultural population, whose products are of great bulk, and nearly all of whose artificial wants are supplied from foreign countries, that the time cannot be far distant when, in the extent and number of its canals, the United States will probably exceed any civilized nation.

Previous to the year 1816 the artificial inland communications of the United States were limited to a very few imperfect and partial attempts. With the exception of the Merrimack Canal in Massachusetts, and the Santee Canal in South Carolina, no continuous and complete line of artificial navigation existed; in all other cases, nothing more had been actually effected, than to deepen and improve the channels of a few rivers, and to pass their more abrupt rapids and falls by means of locks. Thus, a boat navigation, of a precarious kind, had been extended from

the city of Hartford in Connecticut, to Barnet in Vermont, by means of the Connecticut River. Locks had been erected at the Little Falls of the Mohawk River, and a cut made from that stream to one falling into Lake Oneida; and thus a laborious water communication effected from Schenectady to Lake Ontario, and, with the interruption of portages, to some of the smaller lakes in the state of New York. A variety of canals had, indeed, been projected—a few had actually been partially executed—but the public had no faith in their success, and capital could not be obtained to commence those projected, or complete those actually begun. Apathy and distrust attended all schemes of internal improvement; and some new and powerful impulse was required to arouse the attention of the community, and prove the practicability and value of canals. To do this, it was essential that resources, incapable of exhaustion by any excess of expenditure beyond the strict estimates, should be provided, and that an experiment should be made where the revenue would be immediately sensible. To effect the first of these objects, it was necessary to bring into action the credit and revenues of one of the richer and more important states; to attain the second, it was essential to exercise great judgment in the choice of the place where the first portion of canal should be executed.

This important preliminary step was at last made in the state of New York. It was resolved, by its legislature, to pledge the credit of the State, for a loan to make a canal from the Hudson River to Lake Erie; and, in the pursuance of this scheme, a portion of the route was so skilfully chosen, as to satisfy, at once, even the most violent opponents of the practicability and profit of the enterprise. For this successful experiment,—so important not only to the state of New York, and those whose commercial convenience is subserved by this canal directly, but to the Union in general, from the powerful influence it has exerted upon public sentiment.—the United States is in a great degree, indeed we may venture to say, wholly, indebted to the present governor of the state of New York, Dewitt Clinton. At a time of violent political struggle he ventured his influence as a politician, and threw the whole weight of his character and talent into the scale of internal improvement.

Although vehemently opposed by his political adversaries, impeded by the lukewarmness of his friends, and thwarted by narrow views of public economy, he persevered, and succeeded in convincing a majority of the legislature of the correctness of his views; and the resources of the state were embarked in the enterprise. Even in convincing the reasonable and impartial of the probability of the success of the undertaking, he met with much difficulty; and this arose, in a great measure, from acts to which he had himself been a party, but from which he had, on mature reflection, dissented.

The state of New York had, in the year 1810, appointed a Board of Commissioners to examine and report upon the practicability of an artificial navigation from the Hudson to Lake Erie. This board, after some preliminary surveys and investigations, made a communication to the Legislature in February 1811. The duty of drawing this report devolved upon the chairman of the board, Gouverneur Morris, the first named of the commissioners, and who, from his age, his high talent, and opportunities for observing the public works of Europe, was fairly entitled to exercise a preponderating influence over his colleagues. That this influence was exerted in such a way as to preclude them from any collateral inquiries, was most unfortunate; for, while the report exhibited, in a most luminous point of view, the advantages to be derived from a canal, the means proposed for executing it were so unreasonable, as to startle the most excited imagination—while, to the cool and calculating, they rather appeared to prove the impracticability of the scheme, than as fitted to awaken any hopes of its success.—Gouverneur Morris, who had some years before dilated with eloquence on the practicability of a navigation for ships over the contemplated route, did not venture to broach this magnificent scheme in his report. From this he was probably prevented by the better judgment of his colleagues; but he proposed a plan which, if less startling to those who had never seen a canal, or investigated the mechanical principles of hydraulic structures, was equally impracticable in the eye of those who were acquainted, either in theory or practice, with canal navigation. Stripped of a few unimportant additions, the plan was, simply—that the water of Lake Erie should be made to flow into the Hudson

River, upon a plane of uniform descent, and for a distance of upwards of three hundred miles. It is wholly needless to state the objections to such a plan, it being obvious, to all competent judges, that it is not merely impracticable, but impossible, in the nature of things. This very report, then, upon the strength of which Mr. Morris has been held up as possessing a superior claim to Mr. Clinton for useful services in preparing the public mind for the execution of the New York Canal, may be fairly considered as having retarded that great work for several years, and as having had a most marked effect in increasing the distrust with which it and all similar enterprises were regarded. Not only was this plan attended with physical impossibilities, but it included, in its details, mounds and embankments of mountain vastness, aqueducts of miles in length, and, in short, structures of various kinds, to which Egyptian labour or Roman power would have been inadequate.

Mr. Clinton was a member of this commission, and signed the report; nor is it to be doubted, that, confiding in the talent and genius of Morris, influenced by his powerful eloquence and reposing trust in the practical aid furnished by the Surveyor-General of the State, he concurred in it. But his enemies, in seeking to deprive him of all merit, have absolved him from all direct agency in preparing it; while the duties of the most laborious magistracy in the United States * are a sufficient reason that he should not have found time to investigate and reason for himself on the subject.

In the vicissitudes of political life, Mr. Clinton found himself deprived of office and occupation. He seized this interval of leisure to devote himself to scientific pursuits; and, among these, the principles of canal navigation were not neglected. To this we are to ascribe the fact, that, when he was again called upon to act as a canal commissioner, and became chairman of the board, the investigations and surveys, although in many instances performed by the same persons who had been so unprofitably employed under the former board, were now directed so skilfully, as to result in a plan of a canal complete and practicable in all its parts—the determination of a route

* The mayoralty of the city of New York, which Mr. Clinton then held.

so well selected that it has been rarely necessary to deviate from it—and the completion of estimates, that have tallied more closely with the actual cost of construction than, probably, ever before happened in any similar work. The first two of these results might, no doubt, have been attained by the employment of skilful foreign engineers. Such, however, had been the mistakes in estimate committed by those previously employed in similar works, by which, in many cases, the objects had been entirely frustrated, that a well-founded prejudice existed against their employment; and the commissioners were left to their own resources, and the aid of the imperfectly-educated surveyors of the country. The profession of a civil engineer was then unknown; and the means of obtaining knowledge, in that direction, entirely wanting. The other members of the board, however intelligent and active, gladly yielded to Mr. Clinton the labour and responsibility; and, under his auspices the plan assumed a form that stamped it, in the eyes of all reasonable men, as practicable in itself and within the compass of the resources of the State. In this Board of Commissioners, the influence of Mr. Clinton was as paramount as that of Mr. Morris had been in the former. The result, in the one case, was a plan that was anxiously pressed into execution and found practicable; in the other, of an abortive and impracticable scheme.

We have been thus particular in dwelling upon the happy influence exerted by Mr. Clinton in the plan of the Great New York Canal, because many attempts, both direct and insidious, have been made to deprive him of his merit. It is not in the plan alone, but in the system of policy which he introduced,—by which, for the first time in modern history, the whole resources of a community, in revenue and credit, were brought to bear upon a great public work,—that we can look for the most important of the services rendered by Mr. Clinton to his native state, and to his country at large.

Since the impulse has been given by the successful example of New York, every portion of the United States has teemed with plans of public works. Many of these are, in their very nature, either impracticable or useless; others, again, are of the utmost

value and importance. The several local legislatures have, in various ways, aided and encouraged the investigation or actual construction of canals; but in none except Ohio has the bold and successful policy of the state of New York, by which its whole strength was applied to the purpose, been fully imitated. The federal government was applied to at an early period, to contribute its aid to internal improvement, by a grant of public land to the several States, in proportion to the extent and importance of the works of internal improvement they might execute. This failed at the moment, and a constitutional question has since arisen, as to the powers of the general government in this respect, which bids fair to become the dividing line of powerful opposing parties.

The inhabited parts of the United States may be considered as divided into two great portions, the sea-coast, and the western country. Hence, the internal communications may be naturally arranged into three great classes: those which tend to form a line of communication parallel to the coast; those which connect the Western States to the sea-board; and those more partial in their objects and limited in their influence.

The coast of the United States presents a variously indented outline, pierced in several places by great arms of the sea, of which the Chesapeake and Delaware Bays, and Long Island Sound, are the most remarkable. Their very situation and direction appear calculated to elicit the inquiry, whether it would not be possible to connect them, and thus to substitute an internal communication safe from the violence of storms, and easily defended from an enemy, for the more tedious and dangerous passage by sea? This great line of navigation has, consequently, engaged the attention not only of local governments, but of the general administration. Little has, however, been actually effected. We shall proceed to point out the several parts belonging to this system, and mention the condition in which they respectively stand.

The most northern canal intended to facilitate a communication parallel to the coast, is one from Massachusetts to Buzzard's Bay. This has been carefully examined, within the last year, by a board of military engineers, and reported to be

practicable at no great expense. It is intended that it shall be made a navigation for large sloops, but no active steps have hitherto been taken towards its execution.

Long Island Sound, the Bay and Harbour of New York, and the Rariton River, afford an uninterrupted navigation for large sloops as far as New Brunswick, in the state of New Jersey. From this town to the navigable waters of the Delaware, the distance is no more than thirty miles. The country is remarkably favourable for a canal, which might be executed on a level sixty feet above the tide, and requiring, in consequence, about six locks at each extremity. A want of public spirit and liberal views in the government of the state of Jersey, has hitherto prevented its accomplishment. It would not be a difficult matter to show that the tolls, on such a canal, would yield a profit greater, annually, than the whole revenues of that state. Still, however, no argument has been found sufficiently powerful to induce the legislature to take the execution upon itself. On two different occasions, acts to incorporate private companies have been passed, but both have been so clogged with restrictions, as to prevent capitalists from investing their funds. Nor is there any reasonable hope that the object will be speedily effected. The state unluckily labours, and must always labour, under the original defects of its position. Separated from the proprietary government of New York, while the latter was still the apanage of James Duke of York, the limits had no reference to any other object but ease of demarcation. The Hudson separates it from New York on the one side, and the Delaware from Pennsylvania on the other. However definite these may be as territorial limits, they operate, by their facilities of navigation, rather as bonds of union, than as divisions of the inhabitants in their vicinity from those of the two adjacent states. Hence, the citizens of East and West Jersey have different feelings and views upon almost every question of public interest, nor does it appear possible to unite them in exertion by the force of public spirit. It is, therefore, hardly probable that this, perhaps the most important of all the links in the chain of the coast navigation, will be speedily effected, unless the power of undertaking such enterprises be recognised to

exist in the general government, or it should be construed into a necessary preparation for future defence. In this last light, in truth, it may be considered as especially important.

The communication between the Delaware and Chesapeake Bays, has been under more fortunate auspices. It has been intrusted by the States of Delaware, Maryland, and Pennsylvania, to a chartered company, which has undertaken, in good faith and with much spirit, the objects of its incorporation. This canal will, in consequence, be finished and navigable by the close of the year 1828. It is calculated for vessels drawing seven feet of water, and the locks are twenty-two feet in breadth, and one hundred feet in length between the gates. It lies eight feet above the high tides of the contiguous bays, and has, therefore, but one lock at each extremity, besides the tide locks. To effect this plan, there is necessarily a deep cut nearly four miles in length, and seventy-six feet in depth at the highest part of the ridge. The whole canal is less than eighteen miles in length.

The navigation of the Chesapeake is safe and uninterrupted as far as the Capes of Virginia: within these is situated the town of Norfolk, a commercial mart of some importance. The harbour of this city has been connected with the sounds that extend along a great part of the coast of North Carolina, by a canal passing through a vast morass called the "Dismal Swamp," whence the name of the communication is derived.

Albemarle, Pamlico, and Core Sounds afford an uninterrupted land-locked communication as far as Beaufort, in North Carolina. But to render the passage more safe and certain, it has been proposed to cut a canal from Plymouth, through Washington and Newbern to Beaufort. From this last town, a range of islands extends, enclosing sounds, to within a few miles of the mouth of Cape Fear River, with which a communication may be opened at a small expense. Near the mouth of Cape Fear River, stands the town of Wilmington, from which a canal is projected to Georgetown, situated on the river Pedee, in South Carolina. A canal has also been surveyed from this last-named place to Charleston, parallel to the coast. From the harbour of Charleston, a passage exists behind Edisto

Island, as far as the river of that name, and from that river a canal is proposed to unite it to the Savannah, the boundary of the states of South Carolina and Georgia.

The whole coast of Georgia is lined by the sea islands, within which are navigable sounds, and they extend beyond the southern limits of the state as far as the mouth of the river St. John's, in Florida. By means of this last river, or the St. Mary's the southern boundary of Georgia, engineers, in the service of the general government, are engaged in seeking a communication for large vessels with the Gulf of Mexico. That such a passage is practicable is said to be certain; nay, it is said that the government is in possession of papers that prove that one actually exists for vessels of smaller size, which had been used for piratical purposes, before the cession of Florida to the United States.

All the canals we have mentioned, from Norfolk southwards, may be constructed at small expense, as the country is low and level; even tide-locks may, in most cases, be dispensed with.

As an appendix to the artificial navigation parallel to the coast of the United States, may be inserted the navigations of the Connecticut and Hudson's River, and Lake Champlain. These form links of the great chain of communication from the extreme northern frontier to the Gulf of Mexico; and are, therefore, more properly classed under this head than as merely local enterprises.

We have already stated that an imperfect navigation had long existed from Barnet in Vermont, to Hartford in Connecticut, which last place is accessible by the river of that name for vessels of upwards of one hundred tons. This was, however, so precarious and uncertain, that it has been resolved to abandon the river altogether, and construct a lateral canal. For this purpose it has been proposed to leave the river near the town of Northampton, to proceed by Westfield in Massachusetts, and Farmington in Connecticut, to the Port of Newhaven. So much of this canal as lies within the state of Connecticut, is in rapid progress, and will probably be finished during the present year, 1828. That part lying in Massachusetts has also been committed, by a liberal act of that state, to the same incorporated company. Lake Champlain

affords a deep and bold navigation from the Canada frontier to its head at the village of Whitehall; at this place commences the "Champlain Canal" of the state of New York. This navigation receives its waters from the Hudson River by means of a weir thrown across it at Fort Edward. The summit extends north from this twelve miles; the fall towards the Hudson is thirty feet; towards Lake Champlain fifty-four feet; the whole length of the canal is about twenty-four miles. From Fort Edward the passage was at first effected by deepening the bed of the Hudson, and by a few lateral cuts as far as Saratoga, where a lateral canal commenced, extending a distance of seventeen miles to Waterford, at the confluence of the Mohawk and Hudson. Subsequent improvements have, however, been made, so as to form an entire canal from Fort Edward to Albany, crossing the Mohawk just below the Falls of the Cohos. From Albany the Hudson is navigable without interruption, except for a few weeks in the year by ice, for vessels of one hundred tons: ships of five hundred tons may ascend as far as the city of Hudson, one hundred and fifty miles from the sea; and the largest line-of-battle ship may find a channel, nowhere less than a thousand yards in breadth, as far as Newburg, sixty-five miles above the city of New York.

Thus, then, three separate navigations may be considered as centring in the city of New York, two of which extend to the extreme northern frontier of the United States; that by the Hudson, Northern Canal, and Lake Champlain, is completed; that by way of Newhaven to the Connecticut River in a state of great forwardness; the third, intended to open a passage to Massachusetts Bay, and to avoid the dangerous and exposed voyage around Cape Cod, and the shoals of Nantucket, is seriously contemplated, and practicable at a low expense. From New York to the south a chain of inland communication has been investigated, (and one of the most important parts nearly completed,) by which a vessel may pass safe from storms, and out of the reach of a maritime enemy so far as the Gulf of Mexico. When the whole of the links of this chain will be completed it is difficult to predict. Many parts of it are, however, called for to facilitate the local traffic of the districts in which they are situated; others again are important

only as portions of the general scheme. The first of these will, no doubt, be speedily accomplished, now that the spirit of internal improvement has been awakened; the last will probably be left to the general government, and may very possibly remain untouched, unless the necessity be rendered imperative by national wants, as it would be in the event of a future war.

To the second class of inland communications belong those intended to admit a navigation from the sea-coast to the Western States. These two great divisions of country are separated by very marked natural boundaries, in the form of mountains, dividing the streams that flow into the Atlantic from those falling into the Mississippi or into the great lakes. In Virginia, and the Carolinas, these mountains may be considered as forming four parallel chains; and in these states there is no valley that crosses all the ridges: indeed one of them may be considered as entirely continuous, and constituting a complete barrier to artificial navigation, except by the aid of long and difficult tunnels. In Pennsylvania, while the eastern chain of mountains remains distinct, the others spread out and become involved with each other, and the general aspect of the country becomes that of a high table-land penetrated by a few large valleys. This great table terminates in the state of New York, and descends, by a series of steps, to the shores of Lake Ontario. Only a single ridge extends entirely across the state of New York, and even this is cut through at a great depth by the valley of the Mohawk River, at the Little Falls. The easternmost of these chains of mountains is of primitive formation, and may be considered rather as a series of separate hills, than as one continuous ridge. Hence various streams of large size run through the intervening valleys, but none under circumstances to admit of an ascending navigation, except the Hudson. Its tributary, the Mohawk, breaks through the sole remaining ridge by a valley opening from the great basin of Lake Ontario. Of all the other streams that flow towards the Atlantic, none pass through all the mountains with exception of the Susquehannah, whose branch, the Tioga, rises on the western side of the table-land we have spoken of, and, consequently, forces its way entirely through all the

ridges. But the lower part of the Susquehannah is so much obstructed by rocks and rapids, that this circumstance is not likely to lead to any important practical advantage. The state of New York, therefore, in the deep navigable channel of the Hudson and the valley of the Mohawk, possesses natural facilities for opening a communication far beyond those of any other state. These natural advantages were, as we have seen, noticed and partially improved at an early period. They have been finally completely developed by the construction of the great western canal, which affords a continuous and uninterrupted navigation from the Hudson to Lake Erie, and communicates also, by means of a lateral branch, with Lake Ontario at Oswego. This canal is 363 miles in length; the difference of level between Lake Erie and the Hudson is 564 feet; but the canal may be considered as divided into two great but unequal sections, one deriving its waters from Lake Erie, the other from a summit level in the vicinity of Utica. Lake Erie is made use of as a principal feeder from the mouth of the canal as far as Montezuma on Lake Cayuga, a distance of 67½ miles. The descent is 190 feet, by means of twenty-one locks. Beyond this point the canal rises 62 feet by means of seven locks to the summit level; this extends for a distance of sixty-nine miles of level and uninterrupted navigation. The descent to the Hudson is by fifty-three locks, twenty of which lie within the space of a few miles in the vicinity of the Cohos, or Great Falls of the Mohawk near its junction with the Hudson. Besides the lesser aqueducts and culverts by which this canal is carried over smaller streams, it crosses the Genessee River by an aqueduct of nine arches of 50 feet span, and the Mohawk twice by aqueducts of 748 and 1188 feet in length respectively.

The cost of this great work, up to the time it was opened for navigation, was nearly nine millions of dollars; seven millions and a half of which were raised by a loan, for the payment of the principal and interest of which the faith of the state was pledged, along with the receipts of several branches of revenue. These produce about ten per cent. upon the amount borrowed, and hence ensure the liquidation of the debt within a period by no means remote. Thus, then, had the tolls on the canal

been barely sufficient to keep it in repair, the construction of it was entirely within the reach of the ordinary resources of the state. But at the moment of its completion the revenue derived from the tolls became so productive, as to show conclusively that the bare pledge of them would have sufficed, both to pay the interest and extinguish the debt. The income for the year 1826, the first after the navigation was opened from the river to the lake, amounted to 800,000 dollars; for the year ending 1st of January, 1828, it will not fall short of a million. Hitherto, however, the immense receipts have, in a great measure, been absorbed by the canal itself, which can hardly be said to be finished even at the present moment. In the anxiety to reap the advantages its navigation promised, the work was pressed hastily, and, perhaps, prematurely to its conclusion. Hence much was unfinished—much required alteration and repair. The expenditure, however, of the last two years has gone far towards making the canal complete; and in a very short space of time, it will be supported at an ex pense no greater than attends the repairs and care of other similar works. The debt will then rapidly diminish, and it may be confidently anticipated that within ten years the state of New York will possess, free from incumbrance, a source of revenue more than four times as great as the largest amount of direct and indirect tax that has ever been levied. Two parties already exist in relation to the manner of disposing of this wealth: the one would urge its application to the ordinary expenses of the government, and to the extinction of burdens already insensible; the other, with wiser policy, would apply it to the extension of the system of internal improvements by means of canals, and rail-roads diverging from the canal to all accessible portions of the state. The direct tax of the state of New York was no more than the thousandth part of the value of the property paying it. Under the influence of the former party, it has already been reduced to one half. This short-sighted policy has, however, been opposed, and meets with deserved censure from the more intelligent. In reference to this question, we conceive we cannot do better than extract a portion of the message of Governor

Clinton to the legislature of New York, at the opening of their Session in January, 1828. Coming from him, the great author of this successful system of policy, it is worthy of deep attention.

" Considering the high reputation, and the great name, which this state has derived from her internal improvements, it is equally astonishing and mortifying to observe elaborate and systematic attempts to depreciate their utility and arrest their progress. It is manifestly an uncandid and superficial view of the subject, to confine an estimate of its benefits to an excess of income above the interest of expenditure; and yet this standard of appreciation has been adopted. Artificial navigation was established for public accommodation, for the conveyance of articles to and from markets, and revenue is a subordinate object. It was never intended as a primary object to fill the coffers of the state, but to augment the general opulence, and to animate all the springs of industry and exertion, and to bring to every man's door an easy and economical means of access to the most advantageous places of sale and purchase. To narrow down this momentous and comprehensive subject to a mere question of dollars and cents, is to lose sight of the great elements of individual opulence, of public wealth and national prosperity. It excludes from consideration the one hundred millions of dollars, which have, in all probability, been added to the value of real estate—the immense appreciation of all the products of agriculture which were formerly shut out in a great degree from market—the solid and extensive establishment of inland trade—the vast accessions to our marketable productions—the unbounded encouragement of our marine navigation and external commerce—the facility, rapidity, and economy of communication—the creation of a dense population, and the erection and increase of villages, towns, and cities, and the most efficient encouragement of agriculture and the arts, by a cheap supply of materials for fabrics, and of markets for accommodation. But if we were to overlook these important considerations, and confine ourselves to mere questions of revenue, we shall see enough to convince the most sceptical, that immense pecuniary benefits must flow from new channels of hydraulic communication with the

Susquehannah, the Allegany, and the St. Lawrence, and their auxiliary and connecting waters, and by a great avenue or state road from the Hudson to Lake Erie."

The lateral canals mentioned in the above extract, belong to another branch of our subject. This, together with the account of the remaining plans of communication between the Atlantic and Western States, we shall reserve for another paper.

The great canal of the state of New York terminates in Lake Erie, from which it opens a passage for barges of an hundred tons in burden. From the eastern extremity of this lake, an uninterrupted line of internal seas extends to the furthest limit of Lake Superior. The shores of these vast bodies of fresh water embrace a circuit of many thousand miles, every part of which is accessible for vessels of size fitted to bear the tempestuous weathers of these lakes. But one shore of the most of these lakes is occupied by another nation, whom proper considerations of policy will urge to divert the trade into the channel of the St. Lawrence. Much of the shores of these lakes, too, is unfitted in soil or climate to support a dense and wealthy population. The most important extrinsic source of the trade of the New York Canal is therefore to be sought in the states that lie between the great lakes and the Ohio, and even in the extension of artificial navigation to the new countries west of Mississippi. Of these states, Ohio is alone in a position that can enable it to do much at the present period. Of all the states of the Union, it is as yet the only one that has imitated, on a broad scale, the policy of the state of New York, in pledging its resources, in property and revenue, to pay the interest upon, and redeem loans to be applied to, internal improvement. With funds thus raised, a canal has been commenced, and is rapidly making from Cleaveland on Lake Erie to the junction of the Scioto River with the Ohio; another is projected and actually commenced, from the navigable waters of the Maumee, which fall into Lake Erie, to those of the Miami, a branch of the Ohio. What has been executed of the first of these, has already produced a revolution of the trade of the state; as the tobacco that formerly descended the Mississippi to New Orleans, has been forwarded on cheaper

terms to NewYork, and thence shipped to the staples of Virginia and Maryland. The success of this enterprise will probably lead to the establishment of a tobacco staple at New York.

In the early stage of the trade of the countries on the Ohio, their products were embarked in rude vessels that descended by that river and the Mississippi to New Orleans. Here the vessels were broken up for fuel, and the money arising from the sale of the merchandise remitted to Philadelphia or Baltimore: from these cities the returns in foreign manufactures were conveyed across the mountains to the Ohio, and on its waters to convenient points of distribution. The introduction of the steam-boat produced a partial change, in permitting many articles to be conveyed up the Mississippi against its powerful stream. A third change is at hand, by which a great district of country will be brought into communication with New York as a mart both of import and export; while another, equally extensive, will have it in its power to choose between that city and New Orleans according to the circumstances of season, using the former in summer, the latter during the winter months.

Comments on Corpulency.—By William Wadd, Esq., F.L.S.

—— Ridentem dicere verum
Quid vetat? . . . . .

THE celebrated traveller, Dr. Clarke, alluding to the Pyramids of Egypt, says, "the mind, elevated by wonder, feels at once the force of the axiom, which, however disputed experience confirms,—that in Vastness, *whatever be its nature*, there dwells sublimity." Why, therefore, may not the mountains of fat, the human Olympi and Caucasi, excite our attention?—they *fill* a large space in society—are *great objects* of interest, and ought to afford us no *small matter* of amusement and instruction.

It is now nearly twenty years since I gave, in some "Cursory Remarks on Corpulence," an account of all the most conspicuous of these *mountaineers* from the earliest period; and notwithstanding Mr. Malthus's theories for thinning the population, and my own for thinning the person, bodily bulk, or obesity, seems as much in fashion as ever: and, if we judge from the man-

ner in which the jolly gentlemen of the age proclaim eternal war with Maigre and Lent, the march of fat-folks will, at any rate, keep pace with the march of intellect. Nor, is it to be wondered at, when we consider the great improvement in the art of cookery—which has arrived at such perfection, as to bring within the compass of one stomach, what nature provided for two.

"Plures crapula quam gladius"—is an old adage; which, in a free translation, means—Cookery depopulates like a pestilence;—and we have had doctors disseminating this plague, with as much moral culpability, as illegitimate practitioners have the small-pox. This is no new doctrine; it is as old as the days of Seneca, who says, "innumerabilis morbos mirabilis, coquos numera"—we cannot wonder at the number of diseases, when we recollect the number of cooks! For this reason, a celebrated modern physician, when visiting his opulent patients, never failed to pay his respects to the cooks:—"My good friends," he used to say, "accept my best thanks for all the kind services you render us physicians; were it not for you and your pleasing poisons, the Faculty would soon find themselves inhabitants of the workhouse."

But let us speak with reverence of an art that is as old as King Cadmus, and let us recollect that Henry IV. of France was often in the kitchen; that a corps of missionary cooks have been considered the most powerful emissaries to convert the Brahmins,—and that when the devil himself sends us a plague in the shape of a bad cook, infernal malice can go no further.

> Que je puisse toujours après avoir dîné,
> Bénir le cuisinier que le ciel m'a donné.

Were we inclined to philosophise on this subject, we should say—that the portly show—the beautiful rotundity of Burke—and the serpentine line of Hogarth—which exist in the fat worthies of this day, compared with those of former times, are in proportion to the superiority of modern over ancient cookery.

The *bon vivant* of our time turns shocked and disgusted from the black broth, pulse, and meagre fare of the ancients; and his refined taste bestows due contempt on the patriot who could dine on turnips! Agesilaus, Lycurgus, and Cincinnatus, may

have been brave and wise—but would Brummel wish to dine with them?

Athens was little skilled in the higher branches of cookery;—and even imperial Rome considered quantity more than quality. Lucullus, Apicius, and Cælius indeed deserved to have lived in the days of turtle, French sauces, and Kitchener—the great culinary censor of the age. He was, indeed, the "Oracle of Cooks." No man ever possessed a tact of palate more certain, more delicate, or more infallible. He fed with the gravity of a senator—and tasted with the zeal of an artist, whose whole gustatory organs were employed in promoting the progress of his art. In the profundity of his reflections, he usually took three or four hours to digest a peptic precept, or solve a dinner-problem. Hence his opinions became oracular. From his decisions respecting whatever appertained to the art of alimentation, there was no appeal. His opinion constituted law; and should it ever be possible to form a collection of such decisions, it will be hailed as the Epicurean code of the age.

In these days of philosophical fancies, we read a man's history and character at a single glance. As a craniologist will tell you his good or evil propensities—so a physician, by the expression of his visage, will say what he dines upon—and, moreover, (what may not be generally known,) that our personal beauty depends upon eating and drinking; the ugliness of the Calmucks being solely owing to their feasting on raw flesh,—an alarming piece of news to all eaters of (half-dressed) beef, and a convincing proof of the importance of cookery. In truth, as many of our best physicians, and some of our ablest modern surgeons, have demonstrated "that a healthy state of the body depends on the due regulation of diet," the importance of *judicious cookery* must be very evident. Nay, the philosophy of some have carried them so far, as to conjecture that not only the health of the body corporate, but that the safety of the state is connected with this art. Ill-concocted viands not only produce commotions in the human bowels, but

"Convulsions and heats in the bowels of Europe:"

for it is an axiom sanctioned by the highest authority, that well-digested opinions are the product of well-digested viands, and

vice versâ—from which it will appear, the domestic ordering of diet is as important a matter of administration as the Materia medica; and that the Roman general who boiled his own turnips, would, if he had had a cabbage to boil, have boiled it in two successive waters, as he had doubtless discovered that vegetables were "*fade*" and flatulent, unless freed from much noxious matter by culinary process.

Cicero says "old age has no precise or determinate boundary,"—and many philosophers have thought, that men might live, like the patriarchs of old, for centuries, if they took proper means. Proper means! What do they mean by proper means? The answer is—cookery and diet.

"Caro animata cur vivit et non putrescit ut mortua? Quia quotidie renovatur."
SANCTORIUS.

Hippocrates, the great father of the medical and chirurgical art, laid much stress, and wrote largely upon diet. But, during the last century, medical men thought it necessary to apologise for treating on these subjects: since, however, local complaints have been found to be intimately connected with constitutional influences, surgery has taken an enlarged sphere, and they are now entertained as both proper and pleasant.

Fashion, which holds an undivided empire over the frivolous concerns of life, extends its influence even to the healing art. Thus we find fashionable complaints—fashionable remedies—fashionable seats of disease—and fashionable plans of treatment. Half a century ago, "nervous complaints" were the *ton*. These were superseded by "liver complaints,"—and these again have yielded the palm to "stomach complaints." "Duodenal complaints" are beginning to be talked of in London—while the hypochondriacs of Bath have their fashionable localities: so that, at present, the seat of alimentary complaints depends on the accidental circumstance of the patient's residence.

Formerly, we sought the phenomena of insanity in the head and brain—the causes of cough in the lungs and pleura;—but, "nous avons changé tout cela," we look into the head for the causes of hooping-cough, and for the causes of insanity we search the bowels and stomach. In fact, the stomach is charged (now a-days) with one-half the complaints of mankind; and, amongst others, the complaint in question, viz.

Obesity—notwithstanding some fanciful properties given to the colon, as to the secretion of fat. Sir Anthony Carlisle says, that long-continued experience has taught him that the first effects of senility are to be traced to the stomach, and that many incipient disorders are to be sought for in the evidence of the stomach, and its dependencies.

During the reign of *nerves*, camphor-julep and cordials were in vogue. When the popular hypothesis about the *liver* prevailed, mercurial drugs were lavished in a manner that made Dr. Reynolds predict that calomel would be taken by the tea-spoonful. "*Peptic precepts*" perhaps prevented it. The chylopoietic functions put in their claims; and then every body suddenly discovered that they had a stomach! "Don't you think," said an hypochondriac to me one day, "that *dyspepsia* has wonderfully increased of late!" adding, at the same time, "By the bye, what is *dyspepsia?*"

Although gastric disorders and gastric doctrines at present engross the thoughts and employ the pens of all denominations of persons, yet they are by no means novelties. The stomach has been the subject of complaint from the earliest ages. The rich man has complained that his stomach would not allow him to eat *any thing:* the poor man, that it ate *every thing*, and was never satisfied.—And the good Erasmus complained, that in spite of all his Catholic propensities, his stomach would be Lutheran;—and, moreover, a very learned and ancient physician specifically treated this affair, in a grave work entitled "Ventriculi querelæ et opprobia." In truth, it has been satisfactorily proved, that in every stage of human life—health and disease—pleasure and pain—and even life and death, are dependent on the functions of the stomach.

An old English adage says, "it is the stomach makes the legs amble, and not the legs the stomach." Shakspeare knew its importance and powers well: Fontenelle magnanimously avowed that there was no enjoying life without a good one—"pour bien jouïr de la vie il faut avoir un mauvais cœur, et un *bon estomac;*" —and *Serenus Samonicus* many centuries before says,

"Qui *stomachum* regem totius corporis esse
Contendunt, vera niti ratione videntur."

In the vagaries of modern philosophy, it contends for the seat

of the soul; and naturalists have gone so far as to make it the organ of civilization, from the fanciful hypothesis, that animals submit to domestication in proportion to the subjection in which their will is held by their appetite: certain it is, that the stubborn and rebellious are remarkable for their indifference to the pleasures of the table; and that "short commons" and insubordination are uniform, as cause and effect, upon the principle, no doubt, of Sancho Pancha's reasoning—that "when the stomach is full the bones will be resting."

The variation in the capacities and powers of living organs—the peculiarities and deviations from the ordinary course of the human constitution, or what has been termed *idiosyncrasy*, particularly as relating to the stomach, affords much amusing "materiel."

We find sometimes very stout, strong persons, particularly Northern cousins, from some peculiar idiosyncrasy, or some meagrim in the chylopoietic functions, cannot endure certain of the most agreeable and innocent articles of food;—thus fish, flesh, fowl, butter, cheese, bacon, and good red-herring, each in its turn, is despised and loathed. It puzzles philosophy to account for some of these whimsicalities. As for instance, why a man six feet high should faint away at the sight of a shoulder of mutton; why another tall gentleman should have *muttonic* aversions so great, as to be able to point a mutton-pie, as a pointer would a partridge;—while a third "Herculean delicate," minces his meat, and puts aside all fat, gristle, and skin, with the fastidiousness of a puny school-girl.

Another peculiarity that excites our astonishment, is the variety in the capacity and power of the stomach, which enables one man to swallow the whole of another man's grievance,—for there are those who would eat an entire shoulder of mutton in as little time as his *anti-muttonic* neighbour would be recovering from the sight of it*. Much of both these evils arises from the error of early education, and the force of habit; and both are to be controlled, or at any rate moderated by the will, as might be illustrated by some singular examples.

* It is recorded on the tombstone of James Parsons, buried at Teddington, March 7, 1743, that he had often eaten a whole shoulder of mutton and a peck of hasty pudding.

Some men have appeared with the digestive powers of a double stomach, to which the grinding properties of a gizzard seemed superadded. They may have been considered as "nati consumere fruges," and in the scale of living animals, ought to have been ranked with the cormorant or the ostrich. Of these, Marriot, the great eater of Gray's Inn, was a conspicuous instance. He increased his natural capacity for food by art, and had as much vanity in eating to excess, as any monk ever had in starving himself. Nicholas Wood, mentioned in Fuller's Worthies, was another example of great prowess.

These morbid or extravagant propensities of English stomachs, lead us very naturally to believe, that their late majesties from the Sandwich Isles, might, as was reported of them, pick the bones of a good-sized pig; or that an Esquimaux may dine very daintily on a bit of a whale, a Russian on tallow, or, what is still more revolting to our notions, that African gentlemen should eat one another!

Humanity shudders at this barbarous and savage practice, and some humane physiologists have questioned the power of the stomach to digest human flesh, and doubted the existence of Anthropophagi; while others, who are *latitudinarians*, not only allow it omnivorous powers, but affirm that the stomach, in some instances, has been known to eat itself! This, with the feats performed some years ago, by the stone-eater, who gave alarming indications of wishing to devour the marble Father Thames, then just put up in the square at Somerset House, may be considered the very "ne plus ultra" of digestion.

The existence of Anthropophagi, however, is but too true; and when, for the sake of humanity, we had hoped that the practice was on the decline, we are shocked at hearing, that in a neighbouring country, symptoms of cannibalism have appeared, the lamentable result, no doubt, of the high price of provisions; for the Journal de Perpignan contains a detailed account of a family of cannibals being arrested so near our own home as France. But we have another melancholy proof of the existence of this propensity, in people who have not the excuse of the high price of provision, given by John Anderson, Esq., who went lately on a *Mission* to the Coast of Sumatra.

He found what might be considered the fashionables of that part of the world, so vitiated in their appetites, that they could relish no other food, and that they would have swallowed the Missionary much sooner than his doctrines. The royal person who ruled over them was always afflicted with a pain in his stomach, whenever he ate any other than human flesh. A bit of an enemy was considered a treat; and whenever his majesty went to war, besides the ready "sauce piquante" of malignant feelings, he was furnished with salt and lemon-juice.

It does not, however, appear that these Anthropophagi were corpulent, any more than the French prisoner who ate sixteen pounds of raw beef, and other great eaters of meat; whose whole history proves, that the "cœnas sine sanguine," of Horace, possessed more *materia pinguefaciendi.*

While we congratulate ourselves on the diminution of mortality, which has accompanied the improvements in the condition of society,—our pleasure is alloyed by the reflection, that considerable deduction is to be made in our estimate, according to the mercantile phrase, of profit and loss, by the increase of a set of diseases, which are to be attributed to the augmentation of national wealth, with its concomitants, luxury and high-living.

Thus, instead of finding the annual bills of mortality announcing in the deadly list, plague, pestilence, and famine,—not forgetting small-pox,—we read gout, apoplexy, palsy, and even obesity, and a host of minor evils connected with repletion.

Among the grievous calamities incident to corpulency, noticed in a former publication, was its susceptibility of contagion and its proneness to combustion,—and an instance was mentioned of a French lady whose fat caught fire. The Margravine of Bareuth also notices a fat French princess who melted after she was embalmed. I have since discovered, in the Chronicles of Cromwell's time, that these combustible materials in man, were turned to good account in those days, and that a woman who kept a tallow chandler's shop in Dublin, made all her best candles from the fat of Englishmen, and when one of her customers complained of their not being so good as usual, she apologized by saying, "Why, ma'am, I am sorry to

inform you, that, for this month past, I have been short of Englishmen."

Another inconvenience to which the corpulent must submit, is the absolute prohibition from horsemanship, and the difficulty of transportation from place to place, which may be illustrated by the following anecdotes, of late occurrence :—

Mr. B——, of Bath, a remarkably large, corpulent, and powerful man, wanting to go by the mail, tried for a place a short time before it started. Being told it was full, he still determined to get admission, and opening the door, which no one near him ventured to oppose, he got in. When the other passengers came, the ostler reported that there was a gentleman in the coach; he was requested to come out, but having drawn up the blind, he remained quiet. Hearing, however, a consultation on the means of making him alight, and a proposal to "pull him out," he let down the blind, and laying his enormous hand on the edge of the door, he asked, who would dare to pull him out, drew up the blind again, and waiting some time, fell asleep. About one in the morning he awoke, and calling out to know whereabouts he was on the journey, he perceived, what was the fact, that to end the altercation with him, the horses had been put to another coach, and that he had spent the night at the inn-door at Bath, where he had taken possession of the carriage.

A similar occurrence took place lately at Huddersfield. A gentleman went to a proprietor of one of the coaches to take a passage for Manchester, but, owing to the enormous size of his person, he was refused, unless he would consent to be taken as lumber, at 9*d.* per stone, hinting at the same time the advantage of being split in two. The gentleman was not to be disheartened by this disappointment, but adopted the plan of sending the ostler of one of the inns to take a place for him, which he did, and, in the morning, wisely took the precaution of fixing himself in the coach, with the assistance of the bystanders, from whence he was not to be removed easily. Thus placed, he was taken to his destination. The consequence was, on his return, he was necessitated to adopt a similar process, to the no small disappointment of the proprietors, who were compelled to convey three gentlemen, who had previously

taken their places, in a chaise, as there was no room beside this gentleman, who weighs about thirty-six stone!

In enumerating the little miseries of the corpulent, their exposure to ridicule should not be forgotten. Even the austerity of Queen Elizabeth could relax into a joke, on the fat Sir Nicholas Bacon, whom she was classically pleased to define as "Vir præpinguis," observing "right merrilie," "Sir Nicholas's soul lodged well." The good-humoured antiquary, Grose, was earnestly entreated by a butcher to say "he bought his meat of him!" "God bless you, sir," said the paviours to the enormous Cambridge professor, as he passed over their work. Christopher Smart, the translator of Horace, celebrated the three fat beadles of Oxford; and the fat physician, Dr. Stafford, was not allowed to rest in his grave without a witticism:

> "Take heed, O good trav'ller, and do not tread hard,
> "For here lies Dr. Stafford, *in all this church-yard.*"

Our good King Edward IV. even made a practical joke with the Corporators of London; for when he invaded France, in 1475, he took care to be accompanied by some of the most corpulent Aldermen of London, "*Les bourgeois de Londres les plus chargés de ventre,*" that the fatigues of war might the sooner incline them to call out for peace.

Many illustrious cases might have been found in France equal to the specimens Edward took with him, even among royal and noble persons—of which Charles the Fat, Louis le Gros, Sanctius Crassus, and "Corpus Poetarum," the fat poetic Elector of Cologne, were notable instances.

In the court of Louis XV. there were two very fat noblemen, the Duke de L——, and the Duke de N——. They were both at the levee one day, when the king began to rally the former on his corpulency. "You take no exercise, I suppose," said the king. "Pardon me, sire," said de L——, "I walk twice a day round my cousin de N——." About the same time the French Queen, in a haughty tone, demanded of a fat French wit, "Quand il accoucheroit?"—"Quand j'aurais trouvé une sage femme," was the ready reply, which stopped further interrogatories. Nor ought we to omit, among other minor *personal* disadvantages of these great personages, the expense of clothing; and the inconvenience that has been known to arise from

the likeness of one fat man to another, which, during the search for Georges, in France, harassed all the fat people from one end of Gaul to the other.

Having hitherto treated the subject in "merry mood," let us now look at it in a more serious way. Fat is, of all the humours or substances, forming part of the human body, the most diffused; a certain proportion of it is indicative of health, and denotes being in good condition—nay, is even conducive to beauty; but when in excess—amounting to what may be termed OBESITY—it is not only in itself a disease, but may be the cause of many fatal effects, particularly in acute disorders. Many able medical writers of the last century attributed serious evils to the local, as well as the general derangements, that occasionally take place in fat. Many of these might be "whims of a day, and theories of an hour"—fancies dependant on the then physiological and pathological theories, but they speak very positively to certain facts.

Monsieur Lorry, a celebrated French physician, indulged in some curious speculations relative to acute diseases, arising from the admixture of bile, milk, or pus, with fat, in a fluid state. Either of these uniting with the last, in certain conditions of the body, would produce a sort of "tertium quid," in the shape of a soapy liquor, causing acute diseases in some, and chronic diseases in others; and persons have been supposed to die of consumption when, in fact, they were washed away to the other world by their own soap!* Pus and fat mixing toge-

* There is no substance in the human body, M. Lorry observes, more active in reducing fat, than pus. Pus mixed with fat gives it the *solubility of soap.* A purulent mass, and a fatty mass, mixed together, unite with uncommon promptitude. The first effect of this liquefied mass is to produce high-coloured hot urine, which in a few minutes becomes turbid, like badly made soap, when dissolved. It acquires an insupportable odour, and deposits very little red sediment. There floats upon the surface an oily substance, imitating, in colour, the rainbow, the *putrid volatility of which is so strong as to affect the eyes.* The patient feels an oppression about the chest, and difficulty of breathing, which is a little relieved by spitting up a yellow bloody phlegm. Frequently, erysipelatous spots appear on the skin, and become hard; sometimes even the muscular parts become hard, as if penetrated by these spots; in a few days the eyes become yellow, the liver inflamed and painful. This threatens jaundice, which, if it terminates successfully, is carried off by copious bilious evacuations. Hippocrates remarks, that the crisis is fatal, if it happens before concoction, or if the evacuation does not lessen the bulk of the patient, by discharging the whole of the soapy basis of the fat, that has the character of bile. The liver acts as a depuratory organ to the fat, receiving and evacuating the corrupted humours, and may be considered, according to this ancient doctor, in these cases, as the emunctory of the fat.

ther in a gland, became, according to this doctrine, as active as gunpowder, and generally ended in a sort of critical explosion, in the shape of an abscess: the omentum, as might be supposed, was a frequent seat of these combustions. This is confirmed by a celebrated English accoucheur—no less a person than Dr. Leake, physician to the Westminster Lying-in Hospital, and celebrated throughout Europe for his Pilula Salutaria, who, in a book published 1775, describes a species of epidemic fever, that appeared among the pregnant patients, which he attributed to *suppuration of the omentum*. Nor is the mixture of milk and fat, according to these authorities, less terrific. Notwithstanding they both take their principal properties from the aliment, and ought to assimilate, they quarrel desperately when they come in contact, which occasionally arises from a metastasis of milk to the principal seats of fat, particularly the omentum and loins.

It is admitted that corpulent people, when in a state of health, secrete less bile than others; yet, from accidental causes, such as acute diseases, they engender a vast quantity, and it appears as if the liver assumed the power of manufacturing the fat into bile. This gives rise to green bile, black bile, bilious vomitings, and a thousand symptoms, not to be enumerated; and the great Ruysch is even found indulging in some fanciful notions, which involve the Fallopian tubes in the consequences of some of these biliary vagaries.

The immediate action of bile upon fat is not perhaps capable of strict proof, though there are a variety of phenomena not easily accounted for on any other principle. Nothing reduces a corpulent person so rapidly as those sudden bilious evacuations that take place in hot weather. Who has not seen, in what is called the "plum season," a combustion take place, commonly charged to the account of the innocent fruit, that, in the short space of a few days, transforms a fat friend into a delicate dandy! It is, in fact, a bilious, adiposical diarrhœa; and those who have looked into the matter very closely, have detected fat with the bile, and some keen pursuers of animal chemistry have asserted that a fatty substance may be obtained from bile.

Some French physicians have thought that acids gave a character to fat; and it has been questioned, whether the crude

acid, found in the primæ viæ, in some cases of debility, and in the weakness of infancy, do not occasionally produce very active constitutional diseases.

Sir Anthony Carlisle, who has paid great attention to the effects of acids, and has given a scientific analysis of acid substances, says, "that acids not only act upon the stomach and its contents, but they likewise pervade the whole body." Many people are affected with pimples shortly after taking acids; very many are affected with burning heat in the face, immediately after taking vinegar; gouty pains, spasms, and itching over the whole body, are inevitable consequences of the taking acids, with a great portion of mankind. My own father was a singular example of the deleterious effects of acids; and he found, from experience, so much relief from preparations of chalk, that he was never without a box of the Creta preparata in his pocket.

Alimentary acidities are also the causes of erysipelas, and many herpetic diseases; and those who are subject to eruptions on the face, experience a sensible aggravation immediately after taking acids.

External heat may be ranked among the causes that alter fat. Fat people are much incommoded by any sudden transition from cold to heat. In a very hot season, if a fat person undergoes violent exercise, it is possible for the fat, not only to become putrid, and produce petechial fever, but it may become in some parts rancid and soapy, particularly after a previous dry season—at least, so says Monsieur Lorry.

Aromatic substances are also supposed to give a character to fat. From the aptitude of fat to imbibe aromatic particles, it is natural for it to partake of the qualities of the aliment. Thus the odour from the fat of those who live solely on animal food is very fœtid; so with birds, living entirely on fish. It is reported of the French prisoner, who eat many pounds of animal food in the course of the day, that it was scarcely possible to approach him. The odour of garlick remains with those who have eaten it for many days.

Mr. Hunter says, "The essential oils of vegetables and animals, indigestible, are soluble either in gastric juice or chyle, by which means they become medicinal, from their stimulating powers. The essential oil of vegetables, but more particularly

that of animals, would seem to pervade the very substance of those animals whose food contains much oil. Thus, we find sea-birds, whose constant food is fish, taste very strongly of fish; and those who live on that kind of food only during certain times of the year, as the wild duck, have that taste only at such seasons. This fact is so well known, that it was hardly necessary to put it to the test of an experiment; yet, I took two ducks, and fed one with barley, the other with sprats, for about a month, and killed both at the same time: when they were dressed, the one fed wholly on sprats was hardly eatable, it tasted so strongly of fish."—Hunter's *Observations on Digestion*, p. 177.

From the preceding detail, it would appear that the pathological examination of fat furnishes us much matter for reflection on the changes that may be produced in fat, in the living state, by the process of digestion, as also the probable causes of the transmutation of diseased appearances, and the sudden change that sometimes takes place in the character of acute diseases.

Leaving these discussions to the doctors for "Non nostrum inter vos tantas componere lites," we shall proceed to the object of our inquiry, viz. corpulency and its consequences.

[To be continued.]

On the Origin of Air Balloons.

Bristol, December 20, 1827.

SIR,

IT is rather remarkable that so many books having been published on the subject of balloons, and so much money expended in useless experiments to discover a method of guiding them with precision, no one that I know of has as yet pointed out *the origin* of the invention, which will be found, copiously detailed, accompanied by a figure explanatory, in a folio volume, dedicated to Leopold I., by *Francesco Lana*, a Jesuit of Brescia; and published by Rizzardi, of Brescia, MDCLXX. The principal part of this volume is taken up by eight chapters on the subject of telescopes and microscopes, in which he gives directions for grinding lenses, and reflectors of metal, with plans to give the true hyperbolic, elliptic, and parabolic curves, the latter

of which is extremely ingenious, and shows how well all this part of the business was understood in Italy some years before Sir Isaac Newton sent in his first papers on the subject to the Royal Society. There are twenty plates of his own engraving, in outline only, except No. 2, on which he has given a feebly shadowed representation of his favourite invention, the aërial ship, with its four balloons, its mast, and sail; but as the book must be very scarce, it not having been noticed by either *Fontanini*, or Apostolo *Zeno*, or found in the *Floricel* catalogue, I may as well give you the title at length, which is as follows:—

> "*Prodromo*—overo saggio di alcune inventioni nuove permesso all' *arte Maestra*—opera chez prepara H. P. Francesco Lana, *Breccian.* Della compagnia di Giesu, per mostrare li più riconditi principij della naturale Filosofia, riconosciuti con accurata Teorica nelle piu segnalate inventioni, ed isperienze sin' hora ritrovatè da gli scrittori di questa materia, et altre nuove dell' autore medesimo.—Dedicato alla sacra Maestra Cesarea del Imperatore Leopoldo I.—In Brescia, MDCLXX."

The book is beautifully printed in small folio, and has a preface of seventeen pages, on the subject of the state of the sciences in his day, and the necessity of adopting the experimental mode in natural philosophy. Of course, like all the writers of that period, he is verbose, but in many respects very interesting, and, in general, very rational and ingenious. We will now, however, lay aside all criticism, and relate what he writes on the subject of his *balloon vessel*, which is the most remarkable novelty in his book.

After having, in his fifth chapter *of mechanic inventions, to cause birds to fly through the air*, spoken of *Architus's* dove; Baptista Porta's *flying dragon;* the relation of *Aulus Gellius* in his tenth book of the Aldic Nights; *Regiomontanus's* famous *eagle*, which flew to Charles V. on his entrance into Nuremburg; *Boetius's* narration of certain copper birds, which not only flew, but sang; *Glicas's* relation of other similar birds, which belonged to the Emperor Leo; and *Vamiano Strada's* account of those which *Tariano* made for Charles V., to amuse him in his retirement,—he goes on to give the rationale of such contrivances, by four different modes, all very plausible; and then, in his sixth chapter, the title of which is, *How to*

construct ships, which shall be sustained only by the air, and be conducted by means of a mast and sail—the practicability of which is demonstrated, he thus proceeds—

"The human intellect is not satisfied with the above inventions, but proceeds to improve on them by a method, by which *men,* like birds, should fly in the air; and probably the story of *Dædalus* may not be fabulous, since we are told, as a certainty, that a person (whose name I do not remember) in our times, by a similar method, passed across the lake of Perugia, and afterwards, in attempting to alight on the ground, let himself descend with such impetuosity, that it cost him his life. No one, however, has hitherto thought it possible to fabricate a ship to pass through the air, as one does that is sustained by the water, since it has been judged to be impossible to construct a machine lighter than the air itself, which would be necessary to produce the desired effect.

"Hence, I, whose genius ever led me to recover difficult inventions, after long study, conceive that I have obtained my object of constructing a machine lighter than air, which not only, by its own levity, can sustain itself in air, but be capable of supporting men, and any given weight; neither do I fear to be deceived, since the whole can be demonstrated by certain experience, and by an *infallible demonstration* from the 11th book of *Euclid,* received as such by every mathematician. Let us, therefore, lay down certain propositions, from whence may be deduced a practical method of fabricating such a vessel, which, if it does not merit, like that of Argus, to be placed among the stars, will of itself be able to sail towards them."

He then proceeds to describe in what manner he found the weight of the air, by a method then in use, and which is afterwards more fully detailed, when describing the practical part of his machine; and after going through a long series of calculations, founded on the principles laid down by *Euclid,* in his 11th and 12th books, to prove that the superfices of a ball or sphere increases in the duplicate ratio of its diameter,—as, for example, that a globe whose diameter is double that of another—say one of one foot, and another of two—the superfices of the globe of two feet will be four times as large as that of one, and that the solid body of the globe, if two feet increased in a tri-

plicate proportion, will be eight times as large, and consequently eight times as heavy as a globe of one foot diameter; so that the superfices of the larger over the smaller will be as four to one, and the solidity as eight to one. All of which may be easily proved by experience, of which he gives numerous examples in his own experiments with glass globes filled with water, or divested of the air; and then proceeds to calculate to what dimensions *copper globes* may be made, light enough to weigh less than the air they are capable of containing; and comes to the conclusion, by figures, that they may be conveniently made to contain 718 lbs., and that when the air is extracted they will weigh 410 lbs. ¼oz. less than before, and consequently be capable of lifting two or three men. His method of procuring the vacuum is as follows:—He fills his globes of copper, resting on a stage, with water, by means of a plug at the top, and by opening a stop-cock lets it out through a *long* tube into a vessel of water below, and, unscrewing the tube, his globe is in a condition to ascend, but is restrained by cords; and four or more of these globes are bound together, according to the weight of the vessel to be elevated from his *balloon;* to which is attached the boat, furnished with a mast and sail, capable of being turned in any direction, which is to be accommodated with an anchor, also, when proposed to be stationary.

And now, says the author, "I can hardly help smiling to myself, to think that it seems to be a fable not less incredible than that which issued from the voluntary and wild fancies of the head of Lucian; while, on the other hand, I know that I have not erred in any of my proofs, having conferred on the subject with numerous well-informed men, who could not discover any errors in my calculations, and who only desired to behold the experiment, and see the vessel ascend; which I would willingly have gratified them with, previously to publishing my invention, *if the religious poverty I profess had permitted me to expend one hundred ducats, which would be more than enough to satisfy a curiosity so agreeable.* Hence, I must request any of my readers who may be induced to try this experiment to favour me with an account of their success; since, should any errors be committed in the operation, I may

be able to correct them; and, in order to incite others to the trial, I will here resolve such difficulties as may be opposed to the practical operation of this discovery."

He then proceeds to state a safe mode of exhausting the air; and remarks, that some persons may suppose that, from the violence of the rarefaction, the balloon may either be broken, or so bent, as to destroy its rotundity; but in answer to this objection, he replies, that the globes, being perfectly spherical, the air will compress every side alike; so that it is more likely to strengthen than collapse them, as his experience taught him with glass globes, which, when not round, were easily destroyed by the egress of air; but when perfectly so, then they resisted all pressure. Next, he proposes, in order to be secure of this form, that they shall be constructed, first, as two half globes, and then soldered up as one balloon. Again, with respect to the question as to what height this vessel may ascend, since, if they could be raised to the surface of our atmosphere, it naturally follows that the men in it would not be able to respire?—to this he replies, that it could only be supported at a certain height, where the atmosphere was sufficiently dense to sustain it, and that she may be loaded according to the altitude intended to sail in; and would have the power to decline, by merely opening the key of the valve, so as to introduce a certain quantity of common air, and thus they could, at any time, descend.

Again, it might be objected, that she could never sail in any fixed direction, as ships do, who have a resistance from the water; but, says the author, "although air does not resist like water, it still makes some resistance, and if it has less than water, there is less to overcome in sailing; and as there is always some wind, however weak, there will probably be always enough to propel the vessel, and with respect to its being contrary to the course they mean to keep, he has a contrivance to allow the mast to rotate with its sail in all directions."

Lastly, it may be objected, says he, that it will be difficult to overcome the violence of the wind, which may drive them against the mountains—those formidable rocks in this ocean of air, which might overset them; but here, like all sanguine inventors, he finds an easy answer, which is, that the four

globes being above the navigators, they must always be a counter-balance, and until atmospherical air is let in, they need never fear to touch the earth.

"And now," says he, "I can see no other difficulty to putting in practice this invention, except one, which is greater than all the rest; and that is, that God would never permit such a machine to succeed in practice, as it would disturb the civil and political government of the world! For who does not see that no city would be secure from surprise, as these vessels would have the power to place themselves directly over their public places, and thus enter them?" And here he gets heated with horror of the fatal consequences of his new invention, and talks of their cutting ships' cables, throwing down darts, and burning navies, by artificial fires and balls, bombs, &c., killing men, and destroying cities and castles, since, by their height, they might contrive to precipitate mischief on others, whilst they remained secure themselves." In a word, the good Friar, like Uncle Toby, seems really alarmed at last with his own discovery; and I should not wonder if the scarceness of his folio was occasioned by his withdrawing it from general view at last, lest he should be the author of so much mischief to mankind.

I am, Sir, &c.

G. Cumberland.

An Essay on the Remittent and Intermittent Diseases, including, generally, Marsh Fever and Neuralgia; comprising, under the former, various anomalies, obscurities, and consequences, and, under a new systematic view of the latter, treating of Tic-douloureux, Sciatica, Head-ach, Ophthalmia, Tooth-ach, Palsy, and many other modes and consequences of this Generic Disease. By John Mac Culloch, M.D., F.R.S., &c. &c., Physician in ordinary to His Royal Highness Prince Leopold of Saxe Cobourg.—In Two Volumes. Longman & Co. 1828.

Having in a former Number given a brief review of the Essay on Malaria by the same author, we feel it a sort of duty incumbent on us to pursue the subject through its practical consequences, as Dr. M. himself has done, by attempting such an analysis of the present work as the extent of our pages

and the character of our Journal will admit. This practical, or properly speaking, medical work had been advertised in the former; and the author desires that it may be considered as a portion of an entire essay, including the volume on Malaria; while he had been induced to separate this latter, for the sake of general readers, who might not fancy themselves interested in medical writings, or not competent to profit by them. We view this precaution on the part of the author himself, or his booksellers, to have been unnecessary; as there is nothing in the two volumes before us which is not adapted to the capacity of readers of every class, as well non-professional as medical. Consistently with the principle which he has followed in his geological and other scientific articles, it has been this writer's object to exclude technical language, and, as far as was practicable, even technical terms: arguing justly, that it is the facility of stringing phrases of common usage together, which produces that multiplication of loose writings on medical, and, we may add, on many other subjects, out of which it is too often impossible to extract a single novelty or even a definite idea. And when he proposes, as the test of the merit and meaning of such writings, their translation into common English, we cannot but agree with him that this is an operation which would go far to reduce the number of books in our language, not merely on medicine, but on many other departments of science, moral as well as physical.

If the style and language of this book are plain English, and the manner in which the medical subjects are explained, such that they can be understood by any one, and if, very laudably as we think, the author has carefully avoided all those phrases, terms, and allusions, in which medical writers seem to delight, so that these volumes may lie on any table, the subjects treated of are especially of a popular nature—since they concern, we may truly say, every individual; while, without any of the usual pretences of popular books on medicine, they really will enable the people to become their own physicians to a very wide extent, and in the treatment of diseases, among the most universal to which mankind is subject. But for this, indeed, we should not have ventured on a review of this work in our Journal; and it must now be our attempt to render our analysis not less popular and intelligible than the Essay itself. And as we find that some contemporary journals had accused us of incivility in treating somewhat rudely, in our review of Malaria, the very writer whose essays on the same subject we had admitted,

we will, to avoid this adduced inconsistency, confine ourselves to analysis, as far as this is possible. That our remarks however had not offended the author himself, we must presume; since he has, since that, favoured us with a third Essay on the same subject.

This work is divided in such a manner that the first is allotted to the proper fevers produced by Malaria, or dependent on what are commonly called Remittent and Intermittent; while the last treats of those painful diseases of Nerves, which physicians have lately distinguished by the term Neuralgia, and which are popularly well known through that of Tic-douloureux. That both sets of diseases were much in want of elucidation is now most apparent: and if, as has occurred to us in conversation, our author is accused of having invented disorders before unknown, we are among those who would be delighted to find this true, and that every disorder here described was not the sad and painful reality which we know it to be. So far from judging thus, we think that this writer has conferred a most essential benefit on mankind as well as on his own profession,—by investigating, describing, and classifying under certain general and leading principles, what was an entire mass of neglect and obscurity as far as theory is concerned, as, in practice, it was a chaos of empiricism and error: nor do we hesitate in saying that it is the most important contribution which has yet been made to medical science.

And the entire subject has been treated in a scientific manner, as far as the wretched state of medical facts and observations permitted it; the very attempt being a new one, as far as the extent of our medical reading allows us to judge. Our author denies that medicine is incapable of being treated in this manner, and accuses its cultivators of those defects which they choose to consider as inherent in the subject itself—holding out hopes that, in proper hands, it may yet be rescued from the disgraceful condition which, as a science, it exhibits. It is justly remarked, that while all the physical sciences have, in modern times, and through the influence of the Baconian philosophy, been investigated or rebuilt on the solid foundations which this system furnishes, Medicine alone has been indolently contented with proceeding in the manner in which it did in the dark ages; attempting, through words and phrases, to build on the sandy foundation of the very infancy of medical knowledge. And when he says that he has attempted to apply to the object before him the same processes which he has been accustomed to use in the other

sciences which he cultivates; namely, to collect and arrange facts under some general principle, to trace analogies, not in words but in realities, to balance and purify evidence, and, from the generalizations thus formed, to extend conclusions to other facts and analogies, we recognize the true logic of science, and the spirit of the modern philosophy: while, if we cannot help thinking that he neither could nor would have done this, had he not been a cultivator of science at large, so do we agree with him, that the fault of physicians, as writers respecting their own science, has been the neglect of a general scientific education, a want of knowledge and practice in those sciences which are comparatively accurate ones, of that through which alone any one science can be effectually cultivated; since there is not one that can stand upon its own foundation, nor be pursued to any purpose, except through the aid of many others, and through a general habitude with philosophical investigations.

How far the author has acted on this principle, and what the results have been, will be best judged from that portion of the work which treats of Neuralgia. Here it was that the utmost confusion existed, as we shall hereafter show; and it is here that, by the adoption of one general principle derived from facts, and its application to the phenomena of a great variety of diseases formerly judged separate and independent, he has been enabled to bring these under one generic form and one general cause; with the valuable practical consequences of rendering them, for ever hereafter, not only intelligible, but recognizable under whatever obscurities, and with the ultimate result, the end of all medical investigation, that of applying to them one general method of cure. This portion of the Essay, in particular, presents an important example of what medicine can do by adopting the machinery of science; and the consequences are perhaps most conspicuous in the novel arrangement of two most common disorders, Ophthalmia and Tooth-ach: the results of which, in practice, cannot also fail to be most important. If in the portion which relates to Fevers, the scientific train of proceeding is less conspicuous, the results, as well as the processes, are similar: since here also a great number of disorders which were, similarly, judged of an independent nature, and, as such, improperly treated by physicians, are hown to be but symptoms of the one generic disease, Marsh fever, or variations of its varieties; while the utility thence derived will be found in the numerous reforms proposed as to the treatment. It is true that, in our review of his Essay

on Malaria, we doubted that he could make good his general assertion of the community of causes and nature, in this long list of diseases, formerly judged of so very differently: while we much suspect that our doubts were shared by the whole of his profession. All that we can do now is to express our own conviction, while we take no shame to ourselves for not having believed *before* evidence: what may be the decision of the rest of his fraternity, we have no means of knowing; but if he expresses his total want of hope as to the producing of conviction, we really know not how to contradict him—as our own experience in the other sciences has taught us that a teacher and a reformer is always looked on with an evil eye. But he must console himself under the thunders that are accumulating over his head, as well as he can: while, that he will do so is probable, since he seems amply prepared, and therefore little likely to suffer his peace to be disturbed by that abuse under which he seems to have been tolerably well trained.—To proceed to the book itself.

In the work on Malaria, and in the Essay on Fevers, with which he has favoured our Journal, this author attempts to show that no other causes of proper simple fever have been *proved*, than contagion and malaria; the first generating proper Typhus, and the other all the fevers of whatever character that are not contagious: though he makes a reservation respecting what is called Inflammatory fever when it is of very short duration. Hence, in the first volume, he has described all the continuous or remitting fevers which are non-contagious, as varieties of Remittent or Marsh fever; and these form one division in this volume; the Intermittent ones forming the other. Yet he objects to the separation; since these two kinds perpetually pass into each other, as they arise from a common cause; adopting it nevertheless in conformity to popular usage, and thus submitting to some disarrangement and repetition, for which he apologizes on this ground. Under each of these, also, he has arranged certain varieties and variations which he has termed obscure, anomalous, and simulating; and here it is that the chief value of these new investigations lies, since it is from confounding these disorders with others of a very different, and often of a diametrically opposite nature, that have arisen those destructive errors in practice which he has so distinctly pointed out. It being also the professed object of his work to clear up obscurities, to describe what had been neglected, to explain and rectify what had been misapprehended, and above all, to refer to marsh fever under those variations,

symptoms and diseases which had been attributed to common inflammation, or other very different causes, the bulk of the volume in question is occupied on these subjects, while he passes cursorily over that which has been well understood and sufficiently described in other medical writings. Hence that character of entire originality which pervades the whole book: since, with the exception of authorities introduced for specific purposes, we do not find a single passage, and scarcely a single train of thought, which we can trace to any former medical work. So much the worse for his repose: since he will have to endure the fate that no reformer ever yet escaped.

For these reasons we may pass over the first chapter, which is a sketch of the common acknowledged Remittent, introduced merely as a basis of reference, and take up this volume at the second. In this we have a careful and full description of what is commonly called a nervous or low fever: a disease appearing under many different forms, and very generally entirely misunderstood. He shows that Cullen has confounded it with Typhus mitior; while he proves, from its symptoms, its duration, its passage into intermittent, and occasionally from its causes, often to be traced, that it is a variety of the remittent or marsh fever; though not denying that it may possibly arise from other causes than malaria, nor denying, either, that there is a real Typhus mitior, while he shows how these two mild fevers can be distinguished. And if the termination in intermittent is a common event in this disease, as it is a proof of its real nature, so does he show that it is sometimes followed by "periodical head-ach, tooth-ach, intermitting rheumatism, and even marked neuralgia:" facts which serve, in conjunction with many others, to establish the connection of neuralgia in general with marsh fever.

It is also here shown that this particular fever is subject to relapses, and that it thus becomes even habitual: while if this feature, never occurring in the contagious fevers, is a further proof of its nature, a knowledge of the cause becomes most important in practice; since it is through exposure to malaria that the relapses are renewed, and since the only cure is avoidance—not unfrequently change of residence, when an insalubrious air is the renewing cause. Hence the author has been induced to be very full on the subject of this fever when it assumes the chronic or relapsing form: while, if this disorder is as frequent as we should be induced to believe from his statements, and as we know it to be in

certain districts of England, as well as on the Continent far more conspicuously, an accurate knowledge and discrimination of it must be of the greatest importance. And that importance is perhaps even greatest in the slightest cases, since it is those which have been most thoroughly misapprehended. Thus he has shown that a fever of this character is often mistaken for mere debility, (a term, he justly remarks, without meaning,) or for a broken-down constitution, (an equally unmeaning phrase,) or, as attended with peculiar local or attached symptoms, for hysteria, dyspepsia, hypochondriasis, hectic fever, atrophy, consumption, menstrual diseases, and much more, including all those derangements of mental and bodily health to which the popular but vulgar unmeaning, and mischievous term *nervous disease* is so widely applied. And as an instance of this nature, he points out, from Haygarth, as well as from his own experience, a state of peculiar debility attended with nervous affections both mental and bodily, to which young persons, and especially young ladies, are subject; often enduring for years, if with occasional intervals of better health, and exciting much surprise, inasmuch as no organic, or scarcely any really assignable disease is present, while at the same time it is intractable by medicine. This condition he shows to be the very chronic remittent in question; while he proves here, and in other places, that there can be nothing else to account for such a state of things at that age, and where no organic disorders exist. And we deduce generally, from this and other chapters, that he considers the far larger portion of what are called nervous diseases occurring in society, to be the nervous symptoms which belong to this fever; while the proofs are such as to lead to conviction that such is the fact. We need not point out the value of this conclusion to those who know how frequent and how intractable these disorders are, and how currently they are treated by injurious remedies; since, while such evil practices will thus be corrected, we are led to the true and only methods of cure.

Hence there is a sort of general conclusion, for the full proofs of which we must refer to the work, as our limits would not permit us to state them; and it is, that a remittent fever, or that marsh fever, which is so termed, though it be as continuous as typhus ever is, may be a chronic disorder of inveterate and almost endless duration, occupying, in fact, the better part of life. This may be the sequel of a severe and marked remittent, or it may have originally attacked in a mild form: but, while it consists of a series of relapses,

with intervals of better health, or real health, it may, in its progress, become so mild as scarcely to display any striking febrile symptoms, particularly when medical advice is not sought: the appearances being then what we noted above, namely, debility, and so forth; while it is by no means uncommon in this disease for the pulse, the appetite, &c. to remain unaffected, or to be only partially and temporarily disturbed—a fact, to excite no surprise, since, even in very marked marsh fever, the pulse is sometimes not affected, or at least not accelerated. Nor should the existence of such a durable remittent be a matter of any doubt. It possesses an exact analogy to the equally durable intermittent, little known in this country; the difference being, in fact, unessential: while of its reality there can be no question, since it is the very condition of ill health under which those suffer perennially, who are the inhabitants of the insalubrious districts of France and Italy.

There are some interesting remarks in this chapter on the state of the appetite and sleep, and also on the condition of the mind. If we cannot, for want of room, venture to detail them, we must notice, at least, one important conclusion to which they lead: this is, that the hypochondriasis, so common, is very generally or predominantly this very fever, and nothing else; while the author enters here, and elsewhere, into some curious and important remarks on suicide, showing how it is the occasional consequence of a febrile delirium dependent on these chronic fevers, and not either that state of insanity which it has often been considered, nor the consequences of mere moral aberration. We need not say how important this view is as it relates to the treatment of the mental diseases in question. The remarks on that comatose state, which is so common a symptom in these fevers, are scarcely less important: as they serve to rectify those dangerous errors in practice which, by treating this as lethargy, (a term to which no definite notions are attached,) have often produced palsy, apoplexy, or death.

Thus also is it shown, that, as derangement of the stomach is a necessary attendant on this fever as on others, so, many of the cases of dyspepsia which occur in society are nothing else: the most marked affection, in this instance as in so many others, attracting the attention both of the patient and practitioner, when the febrile symptoms are, from their obscurity, neglected; while the possession of a name, a term, such as dyspepsia, hysteria, or whatever else, helps

to mislead those, the great mass, who are guided only by names. On this particular fact we are enabled to confirm the author's remarks, by a wide experience in one of the most insalubrious districts of England: where, while the poorer classes are almost universally subject to this chronic and obscure fever, either in a continuous or intermittent form, the only complaints they ever make are of their "stomach;" dyspepsia, under its endless forms, being so prevalent among them as to be almost universal.

The author proceeds in this chapter to treat somewhat fully of hysteria, and other symptoms of this fever, which are perpetually mistaken for separate or independent diseases: but as we are afraid of exceeding the bounds we have allotted, and also of transgressing on the character of a popular article, we shall pass on—remarking only, that such fevers, with their various symptoms, constitute the general ill health attached to marshy or unhealthy soils, and that he has here offered the means, not only of explaining, but of remedying, a great mass of diseases, always hitherto obscure, while forming a wide cause of torment or inconvenience.

We shall also pass by the chapter on the Proximate Cause, which is little more, and very properly, than a confession of ignorance. Nor will we dwell on the cure, which occupies the fourth chapter, at least in as far as it is but a statement of the usual methods of physic in these cases: it will be better to appropriate the space we can afford to those remarks which are most important as the correctives of past errors. In the acute or severe disease, these relate to the abuse and the hazards of blood-letting; but as these remarks occur again in different places, we shall reserve the whole for a future place. As to the mild and chronic varieties, it is shown that blood-letting, purgatives, or debilitating practices, of whatever nature, are invariably pernicious, and that it is from mistaking this disease for others, in which such practice is recommended, that it is so often rendered inveterate, incurable, or even mortal. Thus also, reversely, a good diet and wine are recommended in cases, where, under the same errors, modern fashion prohibits them; and hence a variety of details in the work, for which we must unavoidably refer to it, from inability even to abridge them. But the final remark is, that when the disorder has become inveterate, scarcely any remedy is of avail but change of air or place; while as the chief value of that arises arises out

of a removal from the ever-exciting cause, an accurate knowledge of the soils or places productive of malaria, becomes indispensable to every physician.

We cannot afford room to analyse the fifth chapter, which treats of dysentery and cholera—slightly, but sufficiently for the purposes in view. These are, chiefly, to show that the latter disease, as well as the former, is the produce of malaria: but we must refer to the work itself for the arguments.

The sixth chapter treats of intermittent fever; but, like the first, passes over slightly whatever is best known and already described, to dwell on errors and obscurities. But as we omitted a most important fact by passing over the chapter on common remittent, we must state it here, since it is one that occurs under each mode of marsh fever, and appears totally unknown to English practitioners, or, at least, entirely neglected by them. We must condense into one place what the author's plan has obliged him to separate.

It frequently happens that the marsh fever, whether its type is to be remittent or intermittent, attacks like a fit of apoplexy; and this is common in Italy, under the term *febbre larvata.* We might consider this as a merely aggravated coma; and so in certain cases it appears to be, since the patient recovers perfectly from it after a certain number of hours—its place being that which would otherwise be the cold fit. But it is either not so, essentially, or is not always so simple: because it sometimes terminates in palsy, hemiplegia or paraplegia, or, perhaps, in an affection more limited; more particularly if evacuations are used. Moreover, the attack is sometimes that of a palsy only, and this under the several forms just described. Hence it is, according to our author, that palsy is often brought on in labouring people, even in our own country, by sleeping on the ground; a fact far more common in Italy, and especially in the insalubrious districts. Elsewhere, in confirmation of this, he remarks, that the application of a certain gas to the eye will produce amaurosis; while, as to palsy, the immediate consequence of malaria, we can confirm his observations by an interesting fact falling under our own notice, where, on the opening of a water-cask, a naval officer was immediately struck down in an apoplexy, which terminated in an incurable hemiplegia.

Now he makes some important remarks on this leading fact. First, he says, that no one English author on palsy has noticed this among the causes of the disease on which he

was specifically writing; and we are unable to contradict him, while it does not say much in praise of the writers, or rather, as is but too true of almost all medical books, the compilers of these works. Hence also he observes, that no English practitioner is prepared for such a cause of apoplexy or palsy, while he refers to numerous cases of it in his own practice, where a complete recovery took place, and in a very short time, by merely doing nothing; while he equally alludes to numerous ones, where, from mistaking the disease for ordinary apoplexy or palsy, it became mortal or incurable. We can easily deduce further, that he holds those diseases, if produced from this cause, as trivial, inasmuch as easily curable; while he says decidedly, in more places than one, not only that they are rendered incurable by the common and blind practice of blood-letting, but that such practice, now unfortunately in vogue, is the common cause of the palsies met with every day in society. And it is plain that he considers the palsies of young people, in particular, to be of this variety, and the evil to be the result of medical ignorance. We need not say that these remarks are no less important than they are original; and we wish that we could contradict what unfortunately a review of what has fallen under our own observation now shows us to be but too true. We have dwelt so much on this fact, however, that we must pass over much more as to intermittent, of less novelty; that we may give a sketch of the remaining "simulations and anomalies" of intermittents (as they are here termed), the account of which occupies the seventh chapter.

We remarked already, from the work, that these varieties had been partly noticed under remittent: but the account here is much more full and detailed; while this chapter constitutes one of the most important portions of the book. And in this case he does not rest so entirely on his own observations as in many other parts; as he has produced abundant evidences from foreign authors, and principally from Strack, as to the existence of these anomalies and simulations; though he is the first writer who appears to have seen their value, as he is the first who has brought them together in a systematical form, and under one leading principle.

These anomalies and simulations occur when, in addition to the simple fever, there is some local symptom of an adventitious nature, such as the palsy and apoplexy just described, or such as inflammations in noted organs, as in

the pleura or intestines, or rheumatism in the muscles or joints. If such symptoms exist with a very marked or acute fever, the variety is termed an anomaly: if either the fever is mild, or obscure, or if it is chronic, and if the accessary symptom is the most conspicuous circumstance, or if it is such that the fever is mistaken for the symptomatic fever of such an inflammation for example, or in any case where the practitioner overlooks or misapprehends the principal disease, or fever, while he ranges the symptom with that disease in which it is, in other cases, the principal one, the term simulating is applied to it; while it is plain that the simulation, in such a case, may depend solely on the ignorance or inattention of the practitioner. Or, to illustrate this by example, if, with the fever, there is violent headach of a phrenitic character, the marsh fever may be mistaken for phrenitis; an error occurring daily to English practitioners in hot climates; or otherwise, a rheumatic affection of the intercostal muscles with a similar fever, mistaken for a symptomatic one, may pass for pleurisy—an error of very frequent occurrence among ourselves.

Now the importance of these distinctions, of an accurate knowledge of these anomalies and simulations, is very great: because, whatever the symptom or simulation may be, the remedy of intermittent, namely, bark, is still the remedy, as blood-letting is pernicious or destructive: while it happens daily, that from mistaking such a disease for true pleurisy, or whatever else, this remedy is adopted, and with the most serious evil consequences. On the whole subject, the author has been very full and minute; while giving authorities and examples, which have also been tabulated at the end of the work, and while also furnishing the most ample means of discrimination: but as we could not pretend even to abridge all this, we must content ourselves with giving an enumeration of these varieties, these anomalies and simulations; remarking only, that they may occur under any type of marsh fever, and in the acute and chronic fevers, both: varying, therefore, in violence and in the power of deception, while also producing varieties of effect, according to the mutual balance of the fever and the accessary symptoms or disease, for which the original must be consulted—though much also must always be left to the practitioner himself.

If we take the list of these simulating fevers which is given in the table to which we alluded, we shall make our own task at least easier, and also facilitate the researches of our readers as to the original, to which we must refer for what we

cannot pretend to detail. To commence with apoplexy, we find that, besides that primary attack which we have already described, it is sometimes periodical, or recurs in place of a cold fit, in repeated attacks; provided at least, that it is not rendered mortal, or converted into permanent palsy, by the destructive practice to which we have alluded in quoting the author's opinion as to the effect of bleeding. The lethargy which we described is also represented as being sometimes periodical; in which case, by comparing it with what the type of the simple fever should be, the discrimination of its real nature becomes easy. Coma is also stated as being periodical; and this simpler modification is so very common, that it ought never, according to the author, to permit any difficulty as to a decision on its real nature. There is here also described what is called an universal palsy, arising from the same cause: a disease so nearly incredible, that had we not seen an instance recently, ourselves, in a very well-known and conspicuous individual, whom it would nevertheless be very indelicate to quote in a public journal, we should scarcely have known how to credit the statements, though one of them is given from a French medical writer of note. Under the same general head, the several modifications of palsy which we mentioned above, are registered as being permanent or periodical; and on consulting the work, we find cases where the paralytic affection, often very complete, occurred in lieu of a fit of the intermittent, or rather, perhaps, as an attendant on it—subsiding again, to be renewed at the next paroxysm: while if, under mistaken views of its nature, blood-letting was resorted to, it became permanent and incurable.

In a second division, termed spasmodic, we find a great collection of the diseases commonly termed nervous, to some of which we have already alluded: while here, as in the former division, we find a mass of authorities in support; to which Dr. M. refers generally through Sauvages; adopting his terms as a mode of reference to the authors whom he has quoted, and to others who are noticed in the work itself.

The first of these comprises epilepsy in its ordinary form, and the analogous disease generally termed convulsions, as it occurs in children; to which we may here add catalepsy, occurring as a species of substitute for the ague fit. Hysteria we have already noticed in the analysis of the chapter on remittent; while it is here classed as being either irregular or periodical: the former variety being that which is most subject to be mistaken, though we recollect many cases of a

regularly periodical hysteria, which we are now at length convinced must have been the very disorder in question.

A periodical spasmodic cough is one of the most singular and deceptive forms under which the anomalous intermittent appears; while the cases given are not only supported by authority, but are in themselves convincing, remote as the connection between such a symptom and intermittent fever may appear to those to whom this subject is new. And we may here make one general remark applicable to the whole, which is this: that, however new, and possibly incredible, all this may appear to the practitioners of our own country, the separate facts seem to have been perfectly understood by the ancient foreign physicians and systematic writers, though they never had formed any generalization of the subject: so that we must now attribute to a want of reading on the part of our fraternity, whatever hesitation or incredulity they may display; a want, we are sorry to remark, which is much too general, and can perhaps scarcely be otherwise, as medical education is now conducted, through lectures and the attendance on shops and hospitals; and a defect also, of which we can see ample proofs, did we do no more than examine the never-opened books that cumber the shelves of medical libraries, replete with stores of knowledge, often voluminous and ill arranged we cannot deny, yet wretchedly replaced by the paltry modern copies and compilations which have so ill superseded them in the reading of even those, the few who do read on medicine.

Asthma, or rather perhaps dyspnœa, is another of the spasmodic disorders found among the simulating intermittents; and of this, at least, we can speak from our own experience; having found it not uncommonly, though, in the cases which we have seen, we should, perhaps, rather have designated it by the term febrile anxiety. In the same catalogue, we find affections of the bladder, termed irritability and strangury: and here also, if we have foreign authorities as well as the author's own experience, we have seen this disease under such circumstances as to make us now suspect that it was what we find here described.

A more frequent and interesting anomaly appears to be the palpitation of the heart, and on this the author is very full; while the proofs which he has adduced as to the reality of this connection appear to be such as to admit of no dispute. And as we have not yet noticed these, we may here remark generally, as to this and all other analogous cases, that they consist, briefly, in the following facts. There is an intermit-

tent, if of an obscure character, and such spasmodic attack is the cold fit or its substitute. If the disease is chronic and there are relapses, one relapse may be pure fever, while another is the spasmodic disease, whatever that may be. The spasmodic disease replaces or puts a stop to the fever suddenly, or, reversely, the fever replaces the nervous affection: or else this last is interchanged with some other anomaly, and so on through a period of years. Lastly, all the collateral and accompanying symptoms are the same, and the nervous disorder is cured and aggravated by the same remedies or treatment as the intermittent; while the ultimate consequences of persistent ill treatment are the same in all; being, namely, palsies, fatuity, and death—or, in the slighter cases, incurable inveteracy.

There follows a long list of nervous affections of the same origin and character, of which some are attended by authorities, while, for the others, we must take the author's word and experience. Among these, we must pass over dyspepsia, chlorosis, hypochondriasis, debility, atrophy, and what are called generally nervous disorders; having already noticed them perhaps sufficiently, and having at any rate no room to dwell on them. After this, mania and fatuity are the most interesting; and here we have the authority of Sydenham, among others, to prove that these are either anomalies or consequences of intermittent fever; while the latter disease, fatuity, is here shown to be a very common result of the evacuant practice in marsh fevers, being by no means rare, as is well known, as the termination of severe cases of this disease. That, in a modified degree, it is a very common result of the delibitating practice in nervous affections, is tolerably familiar; and according to our author, it is the consequence in these cases, of the errors which he has laboured so hard to point out.

As the subject of headach is again treated under neuralgia, we shall here pass it over; as we may amaurosis, for the same reason, and proceed to the list of simulations classed under the term inflammatory. This catalogue comprises pleurisy, rheumatism under various forms, nephralgia, catarrh, and phthisis; together with a fictitious hectic which we have already noticed, and sciatica, which is treated of under neuralgia. The author has endeavoured to show in various parts of his work, and by the comparison of symptoms and dissections, together with the consideration of causes, the transitions of these diseases, the effects of remedies for good and evil, and further, by authorities, accom-

panied by various ingenious arguments, that the inflammatory state of organs or parts in marsh fever is not the same as it is in phlegmasia, and, very particularly, that it requires the reverse remedies; namely, the tonic system, or the remedies of marsh fever, while it is aggravated by the evacuant one. But as we find it absolutely impossible to abridge this important view so as to render it at all intelligible within our limits, we must of necessity refer our readers to the work itself. We can only permit ourselves to remark, that rheumatism is thus considered as nearly allied to marsh fever, and that there is thus explained the utility of bark in that disease: a question which has led to much controversy, as the practice in this disorder is also of the most discordant and opposed kinds. We find ourselves, indeed, trenching so fast on our alloted limits, that we must entirely omit the chapter which relates to the cure of intermittent, as we nearly did before that of marsh fever in its more continuous form; reserving the little space which we can yet command for the examination of the diseases arrayed under neuralgia.

To elucidate this great disease, now first rendered generic, the author has given a tabular view of all the affections of nerves which may be classed under it; and we think it expedient to invert the order of our analysis, by commencing with a general view of what we originally feared would somewhat appal our readers: a fear which the contemplation of this formidable list has not removed; though, were we asked for our objections in detail, and for the reasons why, we should be very much troubled to produce them.

In the first division of this table, we find the painful affections of assignable nerves. The common and well known case of tic douloureux, being a pain in some branch of a nerve of the face, will serve as an example of what is intended by this list, and thus far it is not disputed. The novelty here is, that the same term is assigned to that pain in whatever nerve it may occur, while the reasons for thus generalizing the disease are given; and this chiefly from his own observations, supported in a few cases by other authorities. Dr. M. has given a considerable list of varieties of tic douloureux, (if we may use this term,) which have not yet been recognized as such, or have been mistaken for other diseases. The places or nerves here named are, besides the face, the spinal marrow or nerve, the optic nerve, those of the teeth, producing toothach, the sciatic, causing sciatica, the anterior crural, the spermatic, the radial, the fingers

and toes; while it is presumed that many blanks remain to be filled, as no nerve is considered exempt from this disorder.

Where the minuteness of the nerves renders their exact names or places unassignable, ground is afforded for another division; and in these cases also, it is remarked, that the pain often differs in quality; being less limited and acute than in tic or sciatica, though sometimes resembling it, in consequence apparently of the high sensibility of the parts or the great number of the nervous branches alloted to sensation. It is under this head, perhaps, that the greatest repugnance will be felt to side with our author; but we must trust his fate to the general arguments which we shall afterwards adduce from his statements, while we commence by giving this catalogue. And we will extract this portion of the table as it stands, since it will also serve to give a specimen of the manner in which the whole has been drawn up.

"Of Unassignable Nerves. Pain commonly less acute, or dull, or none, (in this last title the author alludes to the neuralgia of nerves of motion, as in the heart, causing spasms or palpitation only.) Periodical, or irregular

Headach

Common: confined to parts: or general.
Intermitting.
Hemicrania.
Clavus.

Wandering or confined toothach or headach.
Palpitation of heart: no pain.
Palpitation of aorta: no pain.
Palpitation of cœliac artery?
Stomach pains?
Colic?
Kidney and ureter. Decided neuralgia, nephralgic pains.
Bladder and neck: irritability; strangury: no pain.
Rectum.
Palus.
Cauda equina. Lumbago.
Mamma: acute pain. Dr. Alderson.
Knee: pain various.
Shin bone: anterior tibial? considerable pain."

The third division enumerates a certain class of inflammations arising from neuralgia; while, for proof of the truth of this view, we must refer to the few remarks which we shall make hereafter on the author's general theory. The

diseases are, rheumatism under various forms, including, as a very marked variety, that of the face and head, and ophthalmia; that disease already known by the term rheumatism of the eye, but which, in our author's hands, has put on a most important form, since it is proved to be the most common variety of this disease that exists, and also to have been as much mistaken as it has been improperly treated.

Next follows a division of neuralgiæ from injuries, such as wounds, tumours, ulcers, &c.; while we need not specify the varieties enumerated, as they are mere examples of facts, and as this kind may obviously occur any where. For the division which succeeds, entitled neuralgic affections of glands, we must look entirely to Dr. M., of whose theory the fact forms a portion, while the examples enumerated have occurred in the kidneys, producing diabetes, in the lacrymal and salivary glands, producing similarly augmented secretion, and as it appears probable, in the intestinal mucous membrane, and in that of the trachea and nose, generating diarrhœa and catarrh.

Lastly, follows a table of the consequences of neuralgia. These consequences, we must premise by saying, are asserted to occur chiefly when a neuralgia has been of long duration, as also when blood-letting or other debilitating practices have been adopted; yet in some local instances, they follow very speedily, and even attack as the substitutes of the painful disease. The enumerated ones are, mania, fatuity, palsy, and nervous undefinable disorders, as of a general nature; and as partial, amaurosis, contraction of the iris, and opacity of the cornea as a sequel of the ophthalmia, with a few other particulars as to the teeth, into which we need not here inquire.

Such then is this list which, in its tabular form, together with that alloted to marsh fever, conveys an idea not less clear than it is novel, of the extent as well as of the importance of these generic diseases. As to the neuralgia, it is almost superfluous to say, that, with the exception of a very few cases, and those also of somewhat recent occurrence, the term, and not less the disease, had been supposed confined to the well known nerves of the face, and that all the previous essays on it were equally limited; being, if we may use this term in its inoffensive sense, of an empirical as well as a partial nature. Not the least suspicion seems to have been entertained by any previous writer, that this disorder was generic, not local and limited; nor was it suspected that toothach, sciatica, and the other painful affections of nerves

were but the same disease in other nerves, though it seems now surprising how this could have been overlooked. As little had it been noticed that an intermittent fever attended every neuralgia, or that this was in reality but a mode of marsh fever; since the popular term occasionally in use, namely, ague in the head, seems merely to have been adopted from its intermitting character, and no generalization was attempted on the subject. Still less was that ophthalmia termed rheumatism of the eye, supposed to be thus associated, clearly as the proofs are here made out; and while the introduction of toothach into this genus is the novelty which is most likely to meet with opposition, perhaps not less repugnance will at first be excited by the attempt to refer palsies, and even amaurosis, to this cause. Of all this discovery, arrangement, generalization, or whatever else it ought to be called, our author claims the merit; nor, indeed, do we see how we can refuse his rights to originality; while, if our readers shall admit that he has made out his case, (a matter respecting which we intend to reserve our own opinion,) we would point out this as a striking instance of the advantages which medicine, in common with all the sciences, must derive from following the true method of philosophizing; as we suggested already in our introductory remarks.

But we must attempt to abridge the reasons, first, for considering neuralgia as a mode of intermittent or marsh fever; and next, for ranking the several disorders here enumerated under neuralgia.

The application of malaria is the most common cause of both, though that of cold is not excluded, at least as to neuralgia; while it is here also shown that this disease is produced by injuring a nerve, and the more easily, it is suspected, if there is a tendency to intermittent in the habit, or if the situation is insalubrious.

In the same situation, or even house, where many persons are exposed to malaria, some will be affected by intermittents and others by neuralgia under various forms.

The same person, being imbued with the habit of chronic intermittent will, in some relapses, be attacked by mere fever, in others by a neuralgia; and a patient of this nature may have many of the neuralgiæ in the catalogue, in rotation. And in such cases, should the disease recur, even through years, the same hour of attack will be that of the neuralgia, or neuralgiæ, and of the fever also.

A simple intermittent fever is replaced, even in one day,

by a neuralgia, and the reverse; while the one appears to be the cure of the other: and in this case also, the hour of attack is the same in both. Also, a double tertian or quotidian may consist of one paroxysm of fever, and one of neuralgia in alternation; and one case is given where a toothach and an ague fit thus occupied the alternate days for a whole year.

"To these two general branches of evidence, consisting in community of cause and interchangeableness," the author adds another founded on the effects of remedies: the same treatment acting in the same manner cn both sets of disorders, whether the effects be good or evil; and what is also remarkable, the most purely local pain being cured only by remedies that act on the constitution at large.

Further, every neuralgic disease, whatever its character be, is an intermittent, or else a remittent: the types being equally various, and the regularity of occurrences and the durations of the paroxysms similar; while, when chronic, they similarly consist of relapses of a certain duration. And if there be an irregularity, it is in the very chronic cases; while the same irregularities occur in simple chronic marsh fever, and from the same causes. Lastly, that we may cut short that evidence even to superfluity, in which the author's anxiety to prove his case has led him to indulge, every fit of neuralgia, whatever be its nature, is attended by a paroxysm of fever, though this may be obscure, as it is often overlooked: the author having also shown, that the cold stage, which is frequently quite local and limited, precedes the painful one, and that this is simultaneous with, or a substitute for, the hot fit.

Such is the general train of argument; but we must refer to the work itself for the more detailed facts in evidence which do not admit of abridgment.

We must next attempt an abridgment of another of the author's general arguments: it being one of importance, inasmuch as it is that which connects the inflammatory diseases, here enumerated, with simple neuralgia.

During the fit of pain in any considerable nervous branch, the surrounding parts become unusually sensitive and red, or there is increased action in the capillary arteries. If that painful affection be in numerous ultimate ramifications of nerves, the pain is more mild and diffused, while this species of action, tending towards inflammation, becomes generally also more conspicuous. This is what happens in headach, and in toothach very remarkably; and, in the latter dis-

order, it is especially common for this action to become permanent, instead of transitory, in which case the inflammation is established, and is known by the term rheumatism of the face.

To this peculiar inflammation the term neuralgic is here applied: founded on the following facts, and for the following reasons. It is connected with the causes of marsh fever and neuralgia, and also with marsh fever itself, inasmuch as the febrile state appertaining to it is paroxysmal under the same modifications and types. In some cases, such as that of the eye conspicuously, a decided neuralagic pain attends it. In this case also, as in some others, the very inflammation is paroxysmal under all the types of intermittent: ceasing, to be again renewed, and also changing from one place to another, in the manner which is sometimes termed metastasis. Though it resembles common inflammation to the senses, it is aggravated by blood-letting, and cured by bark and tonics. Such is a sketch of the argument, which we have not space to give in more detail, and with more of the proofs here adduced: but we must add that the author considers the neuralagic inflammation, and those which attend intermittent or marsh fever generally, in whatever organs situated, as of the same nature; since those inflammations also possess the very same characters in all respects. And hence is explained the confusion which has hitherto attended the subject of inflammatory affections in those fevers, and very particularly the inefficacy or evil consequences of blood-letting, and the cures effected by bark. Our readers will perceive that we thus come back again, under another form, to the case of rheumatism, as formerly pointed out: and we can only venture further to add, that in a summary and theoretic view which terminates this work, the author suggests the necessity of applying some term to this kind of inflammation for the purpose of distinguishing it from common phlegmasia; as much pernicious practice and injury are the consequences of confounding them, or of mistaking this inflammation for phlegmasia.

Though we cannot venture to take room for all the general views of an analogous nature which relate to this subject, we must still say a few words on the paralytic consequences of neuralgia; while here also another analogy is discovered with the mere marsh fevers, in which palsy is a mode or a symptom, or a consequence. We may commence with the familiar fact, that palsy is not an unfrequent consequence of sciatica, and also of the common tic-dou-

loureux in the face; and the author shows that it similarly occurs in other neuralgiæ: among others, very remarkably, is that of the eye, producing amaurosis. And we consider here especially that his remarks on this terrible disorder are of especial value; since they have not merely pointed out a frequent, perhaps the most frequent cause of a disease, the nature and origin of which were utterly unknown, but also indicated the means of prevention or cure. And if he has noticed that it is common in Africa, where this peculiar inflammation is endemic and the produce of marshy land, for those who have experienced it, to suffer that disorder, which consists in blindness or imperfect vision after sunset, we are happy to be able to confirm that fact by some cases which he does not appear to have met with, in our own country, where the very same disorder was the produce of the chronic neuralagic inflammation of the eyes.

Under this head he has also traced the dependence of mania and fatuity on neuralgia, as he had formerly pointed out their connexion with intermittent; further drawing some curious and important parallels from the effects of cold: but as we dare not follow him through all this reasoning and evidence, we must barely content ourselves with pointing out, that, in this class of disorders as in intermittent, all these effects are the frequent consequences of the abuse of blood-letting, or of the evacuant system generally: some very remarkable cases, in proof, being also given.

But we must abandon what we have not room to pursue any further, that we may give a sketch of his views as to a few of the disorders which he has here treated specifically; selecting those which seem to us the most interesting, as our limits prevent us from doing more.

Under headach he has attempted to trace a regular gradation between the pure periodical disease, which is a neuralgia, and the ordinary nervous headachs, as they are termed: but while we cannot follow him through this, we think that he has done more towards the elucidation of this common and troublesome disorder than had ever been effected before. And in the same chapter there is an important remark on a species of vertigo, which we can assure him is much more common than he seems to imagine, and in which much mischief is daily done by mistaking it, as he remarks, for a tendency or "flow of blood" to the head: a fashionable phraseology, as he calls it, to which he seems to bear a most inveterate spite, as he misses no opportunity of bringing it forward for censure.

The chapter entitled various neuralgiæ, contains examples of the occurrence of this disease in a great number of nerves; while he concludes, that when practitioners shall have learned to pay more attention to this disease under the lights which he has now furnished, that list will be materially augmented.

We believe that some suspicions have lately been entertained that sciatica was a neuralgia; whether or not, the fact is made so clear here, that we shall pass over this chapter entirely, as we must also omit that on the "questionable neuralgiæ," for want of space. That on the neuralgic affection of glands is a subject equally new and curious, aiding also to illustrate the author's remarks on neuralgic inflammation. The singular case of diabetes, which is given in illustration, removes all doubt of the truth of this hitherto unknown or unobserved modification of neuralgia.

That neuralgia may arise from injuries of the nerves, is now fully proved, since various authorities are cited in support of the author's own observations: but he has deduced some valuable conclusions from this fact, a consequence of the generalization which he has adopted as to the whole disease, while hence also he derives a main argument in favour of his theory of toothach.

If these entirely new views of this very vulgar, yet almost universal and most vexatious disorder, which we here find, are the part of this work which is most likely to meet with opposition, we observe that he is fully prepared for that; having, indeed, to use a vulgar phrase, "cried out before he was hurt." It is, perhaps, not the very best policy to begin by throwing down the gauntlet in this manner; but we cannot deny that his remarks on the persecution of all similar reformers are true. This chapter is very detailed and full, containing, indeed, nearly all that is necessary to an entire history of toothach: and if we consider the frequency of the disease and the aggregate of pain which it produces, it is, perhaps, the most important portion of the whole work. That what appears so obvious, now that it is stated, should not have been known or discovered before, is precisely that which will render the present views unacceptable, and the arguments unavailing to conviction; but we will here transcribe the summary of these as we find it, thus saving ourselves the trouble which we have incurred in other places, while we also give a specimen of the author's style, as is a part of our duty as reviewers.

"Neuralgia is a pain occupying some point in the nerves of the face among others; and it may occupy any point in any large branch which supplies the teeth, among other nerves of the face. The pain which it produces is the same pain, whatever be the nerve or part of that nerve affected. The pain of toothach is the same pain, and it is seated in an ultimate extremity of the branch which supplies the teeth, or in more. If the pain is not neuralgia, then it must follow, that although every other point of that nerve, when pained, is suffering from neuralgia, let that pain exist any where, from the brain even to the extremity, the very last, ultimate point thus suffering, suffers from a different disease. *Reductio ad absurdum.*" "Or," as he remarks in another place, "if the inferior maxillary nerve is affected with neuralgia in one point, let us pursue that as a mathematical fluent. It proceeds along the nerve till it arrives at the place where the ramification is given off to *a tooth*: it proceeds even into the tooth, and the *name* is then changed to toothach. But change of name is not change of disease: or, if it be so, let the opposing assertion define the point in this fluxion, where the cessation takes place, and a new element of equation must be adopted, or where a new disease commences."

It is further remarked, that neuralgia and toothach agree in being intermittent and periodical; that if toothach is irregular, so is neuralgia, and from the same causes; that both are attended with a similar, obscure, periodical fever; that both alternate with simple intermittent, by relapses and by paroxysms; that both present all the same types as common intermittent does, and that a double tertian may consist of a paroxysm of toothach on one day, and of simple fever on the other. Further, the same heat, excitement of the parts, diffused pain, and irritability attend both; the two are united or simultaneous, or either passes into the other, or else it becomes impossible to pronounce whether the pain is neuralagia or toothach: while, also, they alternate in such a manner that what was neuralgia on one day, or even in one hour or minute, may be toothach at another, or the next. And, moreover, the case of toothach from caries is precisely neuralgia from the injury of a nerve; this being the most common of the occasional causes, so far from affording an argument against this view; while, lastly, they are both cured by the same remedies, among which, perhaps, the most remarkable circumstance is their cure by means of charms.

Such are the proofs: but as we cannot afford space to enter upon the several interesting details in which all the varieties of this disease are described, traced, and connected

under the general principle, we must content ourselves with a few remarks on the utility or application of these new views.

This is what relates to the cure of this frequent and painful disorder; though, as we cannot undertake to abridge even that, we must limit ourselves to stating what is said generally respecting extraction. Having demonstrated the inefficacy of the barbarous practice of dividing the nerve in the common tic-doulooreux, the author here shows that, in the cases of toothach, as it is reputed, with sound, and even often with carious teeth, the practice of extraction is equally abused, and is often equally inefficacious. In these cases, if the disease is in reality always a neuralgia, it is often, even obviously, that disorder in its plainest form; while, being termed toothach, and from the habit of applying extraction to that disorder, as well as its facility, and also from the defective education or absolute ignorance of diseases of those who practise as dentists, it is resorted to with consequences to the patient that are often very grievous; since, full often, the pain continues or returns after extraction, while the injury experienced from the loss of teeth is not only a great deformity but a serious evil. And if he alludes to cases where whole rows of teeth have thus been sacrificed, often to no purpose, even in young persons, he has stated what must be familiar to every one; while we really are not surprised at his surprise, that such a practice should still be persevered in, even by educated physicians, and that a reasoning so very obvious as he has rendered this, should never before have struck any one. And, as we go along with his reasonings, we cannot help concluding that the consequences of these new views of toothach will become inestimable to the "rising generation," as he terms it: since all that inconvenience and deformity produced by the loss of teeth will thus be prevented in future, and for ever; while the cure of the pain, so seldom effected by these barbarous and ignorant proceedings, will be found in the general remedies applicable to all neuralgia; namely, in the tonic system.

But we must pass on to the only other disorder of this nature on which we can afford now to speak, and which we should not be justified in omitting, important, common, and mistaken as it is. This is the neuralgic ophthalmia, as it is here termed, occupying a chapter to itself, and treated in a very full and satisfactory manner. That it had been confounded with common inflammatory ophthalmia till very lately, is well known to at least our medical readers:

while it appears that our author had long since classed it as he has here done, and treated it on the general principles applied to all the neuralgiæ. Recently, it has been distinguished under the term rheumatism of the eye, by Mr. Wardrop: but we cannot agree with our author that this writer deserves any very great praise for his essay, when he did not discover so very obvious a connection, and while also entirely overlooking the chronic and far most prevailing variety: since excepting a practice in the acuter cases which is merely empirical, he has left the matter pretty much where he found it, and has scarcely aided in diminishing the vast mass of evil consequences, in blindness chiefly, which are its daily produce. That it should so have been overlooked and mistaken by the whole profession, by the entire centuries of physic ever since Hippocrates, might appear perfectly incredible, common as it is and marked as are its characters; did we not know but too well, as our somewhat satirical author justly remarks, what the proceedings of physic and physicians have been during those centuries.

Our author states this as being the most common of all the varieties of ophthalmia; and we are inclined to believe that he is correct in this. It is an endemic in the same situations as marsh fever, very notedly in France, Spain, Italy and Africa; it prevails in the same seasons of the year and periods, and is most abundant in those in which malaria is most active; from all which, as far as community of causes goes, its connection with remittent or marsh fever is established. Its nature is more fully proved by the following facts. It is attended by an intermittent fever of the usual character, and very generally by a distinct neuralgic pain about the forehead or eyebrow: it is also itself intermitting, so as to subside and be renewed again in regular paroxysms modelled on all the several types of intermittent; while, even more remarkably, it is apt to pass alternately from one eye to another, with great regularity, and under a quotidian or tertian type, and while more frequently occupying one eye than both. As a further proof of its true nature, it is aggravated by the evacuating system, and cured by the tonic one; so that nothing is wanting to the proof of its real character and connections, even to this, that a partial or more complete palsy of the retina or nerve, namely the loss of vision after sunset, or absolute amaurosis, is one of its consequences.

As we cannot indulge in a further description of this

ophthalmia, we must content ourselves with stating that it often terminates in opacities of the cornea: while, according to our author, it is this very ophthalmia and no other, which is the common cause of blindness, particularly when that affects one eye only, while even suspected to produce cataract, and very certainly proved to end in amaurosis at times: the very severest cases alone terminating in the total destruction of the eye; but all these bad effects, according to our author, being the consequences of wrong treatment. Nor must we forget to remark, that it sometimes affects the iris; thus also producing blindness by contracting the pupil.

Our readers may now conjecture the importance of this particular disease; and a remark or two from the account of the effects of remedies, for good and evil, will show this in a much stronger light, and evince the very valuable accession which this new view of its nature has made to practical medicine.

It is clearly ascertained by him, and fully confirmed by Mr. Wardrop's experience, though proceeding on different views and on purely empirical or experimental ones, that where it might be a slight disease, it is aggravated by the usual remedies, namely, bloodletting, general or local, blisters, and purgatives; and that to the abuse, or even the use of these, must be ascribed the loss of sight from it, which is so common an occurrence. From this wrong treatment also, that which would have been a transitory case becomes inveterate or chronic, so as often to last even through the whole of life, yet with such intervals and relapses as occur in all the chronic diseases of these general characters. It is the same wrong treatment also which leads to amaurosis or palsy: and the author has given one striking case where, from persistence in this system, mania, fatuity, and death were the results. And when we consider how very common this ophthalmia is, and that the chronic variety, which is even the most common, has been overlooked by Wardrop, hitherto the only guide for it, while, further, that the evacuant practice is followed by every one, mechanically, we shall have no difficulty in seeing the utility to be derived from this new description and correct theory. And as wrong practice is the source of all the evil, so the right practice consists in what is entirely opposed to it, or in the remedies for marsh fever and neuralgia in general, under which it becomes a very manageable, and indeed almost a trivial disease. And if we said that the author had conferred an important benefit on his race by his new views of toothach, these are scarcely to be com-

pared in importance with those which will follow from the diminution of the heaviest calamity that can afflict human nature.

Thus we must bring to an end all that we can possibly venture to take room for; while also apologizing for the length to which our analysis has extended, but which we could not well have curtailed without rendering it useless. We did promise to have extracted some of the author's general remarks on the evacuant practice in its various misapplications; but our limits forbid us to do all that we had intended But as we cannot absolutely omit it all, we must trust to our reader's pardon for the brevity and imperfection of what we can alone undertake to state on this subject.

These relate to that practice, recently become a fashion, as he truly calls it, which consists in bloodletting, cupping, and the use of purgatives, comprising chiefly calomel and salts; and the application, or rather misapplication of these remedies, which he censures, being almost as often the work of patients themselves as of their physicians, is chiefly to the following diseases: to palsies generally, and more particularly to those affections as dependent on marsh fever or its causes, and to apoplexy from the same cause, consequently, and for the same reasons; to an imaginary disease, fashionably, and recently introduced under the term "flow of blood to the head," and very generally to a wide class of nervous affections similarly mistaken for plethora and inflammation, whether arising from chronic marsh fever or from any other causes; lastly, to specific disorders depending on neuralgia and marsh fever, on which we cannot and need not be more particular, after what we have said in the preceding analysis. And we ought to remark that he includes the modern and fashionable recommendation of low diet or abstinence in the same general charge.

He shows, that be the causes what they may, palsies are thus aggravated, or rendered incurable, or even mortal; and that fatuity, and even mania, are thus produced, as is also epilepsy; while in cases of a less aggravated nature, numerous nervous affections of less severity are brought on, and the health of the patient ruined for life. On the imaginary flow of blood to the head, he shows that this is a temporary action of the carotid or other arteries of this part, analogous to that general action of the whole arterial system which occurs in the hot fit of intermittent, and often arising from that disorder in its chronic form, but unsuspected. And he shows that the practice of cupping, and even of purging, or of low

diet, in these cases, leads to ruined health, often to fatuity, palsy and epilepsy, as to long train of other nervous affections: and, attributing the great increase of nervous disorders and of palsies, in modern society, and chiefly in young females in the opulent classes, to the recent introduction and abuse of cupping, so does he denounce the similar self-empirical abuse of purgatives, especially of those most currently used and abused, calomel, salts, and mineral waters. On all this and far more than we dare to quote or notice, we recommend his remarks and his work in general to the serious attention of our readers, and very particularly to the several studious and often fanciful persons, wherever existing, who think that life cannot go on without physic, and who, in the abuse of these powerful remedies, whether from their own notions or the recommendations of routine practitioners, are preparing the way to their graves with thorns and misery.

We would gladly have noticed his last chapter; but we have so far exceeded our bounds, that we must end abruptly; being the more inclined to do this because it is a theoretical view of all that has preceded, stated in a condensed and purely abstract manner, and therefore the less fitted for the readers of our Journal.

On Mineral Waters, Natural and Artificial.

Communicated by Mr. A. Walcker.

The earliest physicians and philosophers regarded mineral waters as an important class of remedies; and in our own days, from the time of Frederic Hoffman, downwards, whom we may justly entitle the scientific restorer of their use, their value has acquired ample confirmation from the evidence of medical writers. Yet, professional men have not been wanting, who have considered mineral waters as nearly inert; and have attributed the cures, performed by them, chiefly to the mode of living resorted to during their use.

That the observance of a strict regimen, relaxation from the business and from the cares of life, together with the invigorating recreations of a watering place, must, in themselves, have a salutary tendency on an invalid, cannot admit of a doubt. If we, however, reflect, that such mineral waters, as are least liable

to decomposition, are used with almost equal advantage at a distance from the springs; that the earliest cures by them were mostly performed on the country people, constantly residing in their vicinity; that, in many diseases, characteristic symptoms occur during the treatment by them; that frequently the cure is not finally effected until some time after the course of waters has been concluded; and that they prove injurious, if misapplied; we cannot but allow them to be highly active remedies. Mineral waters are almost exclusively adapted to diseases of a chronic kind,—the reduction of which, no less than their original developement, is the work of time, and unattended by very striking critical symptoms. Were the fact, however, otherwise, the regimen prescribed during their use should scarcely be looked upon in a different light, than that enjoined with other powerful remedies—as, for instance, with antiphlogistics—the most skilful treatment with which would be rendered abortive, if unaccompanied by a suitable diet.

Physicians have often been induced to think lightly of mineral waters, because their alleged virtues do not appear sanctioned by the results of analysis. But however accurately chemistry may point out the acids and bases, there are no certain means of determining the relative proportions of the binary combinations into which they enter, and on which the peculiar character of a mineral spring, appears, for the most part, to depend. Dr. Murray, who first drew our attention to this point, has shown that, by simply changing the order of combination in which the elements are commonly arranged in our tables of analysis, we are presented with an entirely different view concerning the effects of a spring. Hence, in pronouncing upon its efficacy, experience is our only unerring guide; and analysis can have no further value for the physician, than as it enables him to estimate, from analogy, the medical virtues of a spring, by its synthetical resemblance to another, whose effects he already knows.

The inconsiderate praise sometimes lavished on mineral waters, in recommending them for almost every disease with which human nature is afflicted, has likewise had a tendency to bring them into discredit; for although the cases in which these remedies are applicable, are very numerous, yet, to expect

in them, or in any other medicine, a *panacea*, is absurd. The diseases, therefore, in which they are indicated, are limited in number; and yet it would be unjust towards medical writers, who have treated the subject, to question their veracity, wherever they may have recommended the same water in cases of opposite characters; for, on closer inquiry, we often find that contrary forms of disease originate in the same primary cause.

Thus the confined ideas of a few prejudiced individuals, and the unworthy motives of others, alike fail in depreciating this valuable class of medicines; whose reputation, on the contrary, continues to extend and gain strength, from year to year. Physicians, no less distinguished for the rank they hold in the profession, than for their impartial love of truth, have published the results of their mature experience, in the treatment by mineral waters, and have borne ample testimony to their merits. Germany, from her abundance in powerful mineral springs, has presented the widest field for observations of this kind; and the works of F. Hoffman, Marcard, Becher, Zimmermann, Diel, Hufeland, Kreysig, Wurzer, and others, prove that they have not been neglected.

As we possess no adequate substitutes for these salutary remedies, it cannot but be considered highly desirable to attempt their imitation by art, with a view to extend the benefit of their use to persons whose occupations or whose pecuniary circumstances do not admit of a journey to the natural springs. But almost all attempts of this kind have failed, from the arbitrary and negligent mode of proceeding. Hence the suspicion with which such imitations have been regarded. How far the artificial mineral waters of Dr. Struve have been brought to coincide with their originals, I shall endeavour to show in the following pages:—

An *artificial* mineral water, professing to be a perfect substitute for a *natural* one, must

1st. Contain all the ingredients of the latter; and in the proportions established by accurate chemical analysis.

2d. It must coincide with the original in all physical phænomena, as well as in its impression on the external senses.

In respect to the first point, no branch of chemistry has been the victim of so much abuse as the analysis of mineral waters;

and the labours of a master in the art, have been rarely adopted as the basis of an artificial preparation. The fallacious notion, too, that a knowledge of the effects of a mineral water was deducible from the ingredients, as they are enumerated in our tables of analysis, became another source of failure. Imitations were considered satisfactory, if they but contained those few substances that preponderate in the originals, and which are known in themselves as possessed of medical power; whilst others, either existing in smaller proportions, or whose curative virtues, under the form our tables of analysis gave to them, were less striking, were either entirely omitted, or added in incorrect proportions. This error was particularly frequent with regard to the oxide of iron. I have already once had occasion to observe, that a mineral water is by no means to be regarded as a mere solution of those salts enumerated in our tables of analysis, co-existing without reciprocal decomposition. The earthy carbonates, for instance, which, as such, would be of little medical value, exist in mineral waters in the form of sulphates, muriates, and bi-carbonates, the efficacy of which cannot be disputed. Silica, which in its state of solid aggregation, is indolent, exists in the waters as a soluble silicate*.

The carbonate of iron, however minute its proportion may be, has no inconsiderable share in modifying the effect of mineral waters. Repeated observations have proved that in the artificial Carlsbad waters, for instance, if the small quantity of iron be omitted, they become possessed of the debilitating tendency which saline aperients generally acquire, when used for too great a length of time†.

* It is sufficiently known how little we are allowed to transfer our therapeutical notions of an insoluble body, to the same when in a state of solution. I allude merely to the different effects of metals and their insoluble sulphurets, compared with their soluble salts. The different intensity of aggregation—even a minuter state of mechanical division—frequently implies a considerable change in the medical virtues. Calomel, prepared viâ humida, or via siccâ; sulphur, sublimated or precipitated; oxide of iron, before or after ignition; fluid mercury, or those preparations wherein it is minutely subdivided, &c. &c., furnish proofs of this statement. The action of many of our antidotes, by their entering into combinations, relatively insoluble, must be referred to the same principle.

† The salts of strontia, barytes, lithia, together with the fluates and phosphates which some mineral waters yield, occur in proportions too trifling to admit of any stress being laid on their medical effects. How far this remark applies to the more prevalent manganese, which proves, from the late experiments of Professor Gmelin, powerfully to affect the biliary secretions, we may not be too forward in presuming. Be this as it may, it rests incumbent on chemists who profess to imitate a natural spring, to omit no one ingredient, however inconsiderable it may appear.

Having thus compounded a mineral water, with strict adherence to the first position, it remains to impart to it the exact temperature of its prototype; to submit it to a corresponding pressure of carbonic acid gas, excluding at the same time, especially if it be a chalybeate, every particle of atmospheric air. With the observance of these requisites, we shall succeed in obtaining a mineral water, which is not to be distinguished from the spring. It will coincide in appearance, taste, smell, and other physical properties, with its original. The gas-bubbles will rise in the same form, and spontaneous decomposition will take place within the same period, and to the same extent. That these external bearings must be punctiliously attended to, I shall endeavour to prove more at length. If an artificial mineral water, whose original contains no other gas than carbonic acid, be not perfectly free from atmospheric air or other gas, it will deviate in quality. Its capacity of absorbing and retaining carbonic acid, being impaired, the latter escapes more easily, more rapidly, and in larger bubbles; and the decomposition of the mineral water, that is to say, the precipitation of the earths and of the oxide of iron, ensues in a similar ratio. It cannot, however, be looked upon as a matter of indifference, whether this decomposition ensues earlier or later in the organs of digestion.

Factitious mineral waters thus corresponding with the properties of the natural ones, will resemble them to the same extent in their effects on the human frame. Since the year 1821, Dr. Struve has erected establishments for the purpose of their exhibition, at Dresden, Berlin, Leipsic, Kœnigsberg, Warsaw, and Moscow. Most of the physicians in those towns are practically acquainted with the natural springs. The numerous cases which they have contributed to Dr. Struve's treatises*, and to several medical journals, bear satisfactory testimony to the coincidence of their medical virtues; and the public, who formerly were in the habit of resorting to the natural springs, now entirely confide in these imitations.

Although these facts have been acknowledged by the faculty in general, a few medical writers have, nevertheless, attempted

* Ueber die künstliche Nachbildung der Heilquellen. I[ster]. and II[ter] Theil, 1824 and 1826.

to maintain, that art can never succeed in closely following up nature, in the reproduction of a mineral water. It is worthy of remark, that this objection has been raised almost exclusively by superficial chemists; whilst men whose whole lives have been devoted to the cultivation of the science, have abstained from expressing such doubts. The importance of the subject, however, still demands, that the grounds on which the objection rests should not be passed over in silence. We shall, therefore, proceed to examine and to reply to them.

Foremost, we may class the hypothesis, which ascribes the virtues of mineral waters, in a great measure, to the agency of imponderable bodies—especially to electricity. To this, the baths of Pfeffers, in Switzerland, and of Wilsbad, in the kingdom of Wurtemberg, chiefly gave rise. Both are highly esteemed for their medical powers; but as their efficacy does not directly follow from the results of their analysis, (according to which, the amount of their ingredients, whether of a fixed or of a gaseous kind, is inconsiderable,) the *imponderables* were pressed into the service. Not to dwell on the circumstance that we possess no modern analysis of these springs, we have only to keep in view the powerful influence which thermal baths, even of common water, exert over the frame; and we shall no longer feel surprised at the effects of a system of bathing, such as is followed at Pfeffers, where the patient gradually lengthens the period of his baths, from one to ten or twelve hours.

Even admitting electricity to be instrumental in the primary formation of a mineral water, the idea of its permanent activity is at variance with all experience in electrical phenomena. The hypothesis, however, appeared to acquire strength from the theory of Becquerel, who, from the action of certain substances on the electro-magnetical multiplicator, when brought into contact with it at the moment of their becoming united, was led to infer, that a disengagement of electricity accompanied the chemical changes. Subsequently to the publication of this opinion, Professor Kästner, of Erlangen, attempted to prove that the springs of Wisbaden, in the duchy of Nassau, manifested electrical phenomena, dissimilar to those of an imitative chemical mixture. The fallacy, however, of the inferences drawn by the French philosopher, has since been laid open by

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Sir Humphrey Davy*, and my own experiments †; and, on following up the experiments of Professor Kästner, at the mineral springs on the Rhine and in Bohemia, I ascertained that they evinced no signs of electrical action whatever, and that their mode of affecting the electro-magnetical multiplicator differed in no particular from that of an artificial mineral water, containing the same ingredients. The source of the error into which Professor Kästner had fallen, I have pointed out in an earlier number of the above-mentioned philosophical journal ‡. Thus experience subverts the first ground of objection.

Another is, that the warmth of thermal springs is different from that obtained by artificial means. They have been asserted to produce a different sensation on the frame, and to demand a longer period for the reduction of their temperature than common water heated to the same degree.

If the sensation produced by a naturally thermal bath differs from that of common water, heated to the same temperature, the reaction caused on the skin by the ingredients of the former must be taken into account. With respect to the greater length of time which the mineral water is supposed to require in cooling, the circumstance has been disregarded, that the bathing reservoirs, being mostly constructed of such materials as belong to the worst conductors of heat, retain a temperature little inferior to that of the bath itself. Nor is it possible, in a close chamber, where no current of air is permitted, and whose atmosphere, consequently, soon becomes saturated with vapour, that the temperatue of the water can be sensibly diminished by evaporation.

Authenticated proofs, however, afford us a still better means of refuting such gratuitous assumptions. With this view, M. Longchamp submitted the waters of Bourbonne,§ which prior examinations ‖ had endowed with a different capacity for caloric than a corresponding factitious mixture, to a careful and minute course of experiments; and the results proved that the water

* *Vide* Philosophical Transactions for 1826, III.
† *Vide* Poggendorff's Annalen der Physik, 1825, Nos. 7 and 8.
‡ *Vide* Poggendorff's Annalen der Physik, 1825, No. 5.
§ *Vide* Annales de Chimie et de Physique, tom. xxiv. p. 247.
‖ Recueil des Mémoires de Médecine et de Pharmacie Militaires, xii. p. 21.—Paris, 1822.

of naturally warm springs, and water artificially heated, *cæteris paribus*, require the same time to cool; a fact which has since been confirmed by the experiments of Professors Reuss, Neumann, and Steinmann, on the waters of Carlsbad; by Professors Schweigger, Ficinus, and Reuss, on those of Töplitz, and by Dr. Salzer, on the springs of Baden, near Vienna.

On a closer inquiry into the theory of the formation of thermal springs, the positions laid down for the origin of their temperature offer us no grounds to assume in them an extraordinary capacity for caloric. The hypothesis which derives their heat from the decomposition of pyrites, or from beds of burning coals, has found its refutation in the chemical and philosophical reasonings of Professor Berzelius;* and the view which he himself has shaped out, has, from a multitude of facts, by far the greatest title to probability.

Hot springs, he observes (as well as exhalations of gases and of steam), occur in the vicinity of all active volcanos; it is, therefore, probable that such waters owe their temperature to their passage through channels heated by volcanic fire. With regard to the other fervid springs we are acquainted with, most of which will be found to lie contiguous to extinguished volcanos, or at least in a soil bearing the stamp of volcanic formation, there is reason to suppose, either that volcanic action still goes on in the interior of the earth, or that glowing masses, the remains of primeval volcanic processes, still exist there. That the former case obtains, with reference to some springs, seems evident from the earthquakes that have been experienced in their neighbourhood; and the possible existence of glowing masses in the interior of the earth, and requiring thousands of years to cool, will be conceived with less difficulty, when it is considered that volcanic productions are amongst the worst conductors of heat; yet wholly enveloped in immense strata of such as these glowing masses must be, they can only part with their temperature by conduction—never by radiation.

Of the remarkably bad conducting power of volcanic products we are furnished with abundant proofs. Thus, Sir William Hamilton observed, in 1769, that the lava which flowed at Vesuvius in 1766, was still smoking. During the eruption of

* Vide Transactions of the Royal Academy of Sciences, at Stockholm, 1822.

February 1822, Messrs. Monticelli and Covelli discovered in a crater of Vesuvius. a layer of snow, of a foot in thickness, and which had lain there for a couple of days; nor did these gentlemen experience the slightest inconvenience on applying the hand to the margin of a canal, formed of congealed lava, although a stream of red-hot lava was flowing through it at the time.

In considering the origin of thermal springs, I cannot omit adverting to the warmth that prevails in the interior of the earth. Observations made in the mines of Cornwall and other districts have shown, that, at no great depth, the temperature is augmented in no inconsiderable degree. Thus, in a mine of New Spain, Von Humboldt found the temperature at a depth of 1647 feet, to be 32 degrees higher than at the surface. To the influence of this principle, in imparting warmth to the penetrating atmospheric fluid, Professor Berzelius and, with him, M. Brognard are inclined to attribute the less ardent temperature of springs, like those of Bath and Clifton, as the soil in which they are generated has not a volcanic character.

The next objection urged against factitious mineral waters, is, that the means which Nature employs in their formation are enveloped in mystery, but that they probably differ from those which are in the power of Art.

This objection is obviously devoid of meaning It is the properties of the two products that it is our business to compare, and not the causes that co-operated in their formation,—for the cause ceases in the effect. Sufficient reasons were, however, thought to have been discovered for overturning the ancient Plinian doctrine: "tales sunt aquæ, qualis terra per quam fluunt."

The aggregate quantity of water flowing from the source of the Sprudel, at Carlsbad, in a single year, is calculated to contain fourteen millions of pounds of carbonate of soda, and nearly twenty-two millions of pounds of Glauber's salts. This quantity, multiplied by the number of years the Sprudel may be supposed to have existed, (and it has flowed to our knowledge for nearly five centuries,) appears so enormous, that nature was assumed to have fixed on the inmost recesses of the earth for her laboratory, and there, aided by the powers of elec-

tricity, to have created the mineral waters out of the elements of their component parts. And this hypothesis seemed to be favoured by the circumstance, that no saline strata occur in the vicinity of the wells,—such immense strata of sulphate of soda, nowhere.

On, however, taking a general survey of those mineral waters which resemble each other synthetically, we shall become aware of the same analogy in the geognostical relation of their vicinities. The critical eye of Berzelius was the first to light upon this fact with sufficient clearness. Thus, springs abounding in the salts of soda are only to be met with in the neighbourhood of volcanic mountains; as, *for instance*, in the basaltic chains which traverse the north of Germany, from west to east, in the Pyrenees, in the Auvergne, in the Vivarais, and in the Cantal. On the other hand, where the basaltic formation is not prevalent, as in the Alps of Switzerland, the salts of soda occur but sparingly in mineral waters, and its carbonate is altogether absent.

Hence, as volcanic fossils, such as clinkstone, basalt, obsidian, lava, &c. alone contain soda to any amount, we may safely conclude that these minerals are subservient to the formation of mineral waters. Direct experiments of Dr. Struve have shown, that by the treatment of certain fossils with water and a concomitant pressure of carbonic acid gas, solutions are obtained, which bear analogy to the respective mineral waters occurring in the vicinity of the fossils in question. Such was the case with the clinkstone of Bilin, the porphyry of Töplitz, the basalt of Eyer, the marle of Seidschutz, and the loam of Püllna in Bohemia.

The development of carbonic acid gas, a leading ingredient in mineral waters, is likewise connected with volcanic action. The evolution of this gas, consequent upon every eruption of Vesuvius, and the perpetual streams issuing from the earth near volcanos, as in the Grotto del Cane, near Naples, and at various parts in Sicily,—place this fact beyond a doubt. Besides, these exhalations of carbonic acid gas are only observed either near extinct volcanos, or where the formation of the soil clearly denotes a volcanic origin.

To examine all the means which volcanism may possibly

employ in the production of carbonic acid gas, would exceed the limits of this paper. We shall content ourselves with observing, that, for chemical reasons, its creation out of its elements is far from probable; as it must, in that case, necessarily come forth, adulterated with azote, carbonic oxide, or even with empyreumatic oil. Hence, in the volcanic laboratory, it can only be produced by a decomposition of the carbonates—which may be effected by a variety of processes, conformable with the laws both of geology and chemistry, but which we have not here room to specify.

The probability, however, is, that these processes vary, according to the different features of the soil; but that the development most commonly results from the ignition of carbonate of lime—the decomposition of which requires less heat, when it is brought into contact with steam or silica.

It might perhaps be expected, that where carbonic acid gas is thus produced in large quantity, its temperature should necessarily be elevated; and the Vesuvian grottos receiving this gas have been ascertained, by Messrs. Monticelli and Covelli, to exceed in temperature, by 4½ degrees, the grottos which contained it not.

The very general occurrence of carbonic acid gas throughout the globe, proves that Nature has other means for its production in smaller quantities. Dr. Struve has found that carbonic acid gas is disengaged by bringing carbonate of lime in contact with silicate of alumina and water, at common temperatures, though more readily if the latter be heated. To this process of development, common spring water is perhaps indebted for its small portion of this gas.

With regard to the acids in the sulphates and muriates of mineral waters, where the surrounding rocks yield only the respective bases, volcanic action seems to be the principal agent in their production. To notice all the facts, however, which appear to favour this or other hypotheses, would spin out the present paper to far too great a length. They have been collected and revised in an elaborate work, by Professor G. Bischoff, of Bonn*.

* Die vulkanischen Mineralquellen Deutschlands und Frankreichs, deren Ursprung, Mischung und Verhæltnisse zu den Gebirgsquellen, 1826.

It has been questioned whether the ingredients consumed by very copious springs should not in process of time leave such cavities in the interior of the earth, as to occasion chasms on its surface. The following calculation will render apparent the improbability of such an event, and will at the same time serve to show how inexhaustible is the fund of materials which mountainous districts have in store, for the supply of mineral waters. It refers to one of the most abundant springs we possess.

The quantity of water yielded by the Sprudel fountain at Carlsbad,* through its several mouths, averages per hour, 419,200 pounds, therefore, per year, upwards of 3672 millions of pounds. The quantity of oxide of sodium, in the salts of soda, which this mass of water holds in solution, amounts to. 60,232,59 lbs.

Now the Donnersberg, a mountain of the Bohemian chain, and constituting an almost perfect cone, consists exclusively of clinkstone, of a specific gravity of 2.575, and whose constituent proportion of soda is 10.¼ per cent. Assuming its elevation at 2500 feet, (although it is in reality higher) and the inclination of its sides, towards the horizon, only at 45 degrees, it follows that this single mountain contains a quantity of soda sufficient for the supply of the Sprudel, during a period of

* These celebrated springs are situated in Bohemia, and were originally discovered by the Emperor Charles IV., whilst engaged in the pleasures of the chase. Being attracted into the rocky glen, where they rise, by the howling of one of his hounds, he perceived the animal struggling in the hot well into which it had fallen whilst in pursuit of a stag. This occurred in the November of 1344, the year of the memorable battle of Cressi, wherein the Emperor had been wounded in the thigh, whilst fighting under the banners of Philip II. of France. Charles was subsequently induced by his physician, Peter Baier, to try the recently discovered waters for a protracted evil, arising out of his wound, and from the success attending their use, the springs were named after this Prince.

The origin of these wells must have taken place at an extremely remote period. Professor Berzelius assumes it to have been coeval with the violent revolutions in nature, by which the valley of Carlsbad was created; which hypothesis is strongly supported by the circumstance, that the covering of the subterraneous reservoir (called there the kettle) of the Sprudel-fountain, composes, for a considerable extent, the actual bed of the river Tepel, and must, therefore, have existed before the valley was excavated to its present depth by the river. The lid, as it were, of this boiler, in some places eight feet in thickness, is composed of the earths precipitated from the water. It represents a lime-stone of the hardness of marble, assumes a polish, and consists of parallel strata, varying in every shade, from dark brown to yellow and white. Over this lid, which is of considerable extent, the greater part of the town of Carlsbad is built, and the water issues forth through several openings, which it is found requisite to widen, from time to time, by boring, to prevent the dangerous consequences of an explosion of the lid.

35,000 years; and yet this mountain is inconsiderable in size, compared with others of Northern Bohemia, and these, consisting of clinkstone, basalt, or other rocky substances, more or less rich in soda. Nor would the aggregate solid contents of the Sprudel, supposing the latter to have flowed, in its present ratio, for the last 7000 years, that is to say, from the remotest era of history downwards, occupy so enormous a cubical extent as might be imagined: for the entire quantity of its salts, thus amounting to 70,175,589 tons, and their specific gravity being 2.279, would not constitute a cube of more than 996 feet. Surely a space like this is a mere bubble in the interior of the globe; and, ere we expect the earth to give way, let us remember that when a fossil becomes decomposed, its volume is often simultaneously increased by a change in its aggregate form.

If we reflect on the foregoing, together with many other phenomena, such as the connexion obtaining between some springs and the affluent atmospherical water, we cannot help subscribing to the opinion, long entertained by chemists, that the formation of mineral waters is a simple process of solution, subject, therefore, to the established laws of chemical affinity. Their variety, consequently, depends on the different nature of the strata through which they flow,—upon the relative quantity of water and gas acting upon these strata,—and upon the various degrees of temperature that are enlisted in the process.

Another argument opposed to factitious mineral waters is, that although chemical analysis has the power of ascertaining the acids and bases, still it is not possessed of the means of determining in what combinations they are united in a mineral spring. That the actual combinations differ from those of our analytical results, is certain; and as the effects of the waters on the human frame do not satisfactorily correspond with the latter, Dr. Murray has been led to conclude that the elements in a mineral water unite under the form of the most readily soluble salts. The Doctor contrived this theory chiefly with a view to account for the effects of the Dunblane waters: but the results of his own chemical investigations, and the effects of mineral waters, in general, are far more clearly elucidated in the theory which Berthollet has so ably conceived, and

which is borne out by a multiplicity of facts and reasonings—a view which Professor Berzelius, and probably most other chemists, have now embraced. According to its principles, a common solution of several salts, and hence a mineral water, contains as many different salts as the product of the number of its bases by the number of its acids. Thus the Carlsbad water, which yields six different acids and seven different bases, contains forty-two various salts. Should it be asked, what is the exact proportion of each of these salts in the water, this will depend upon the quantity of water, and its temperature upon the actual quantity of the acids and bases, and upon the degrees of their mutual affinities. In the total absence, however, of a numerical proportion relative to the last position, and in our incapacity to ascertain what changes temperature may produce in the affinities, we are at a loss for an adequate answer. As far, however, as regards the point at issue, this matters not; for, provided a factitious mineral water contain the same ingredients in a state of solution, and in precisely the same proportions, provided it receive the same temperature and be subjected to the same atmospherical pressure, it must necessarily become subject to the identical laws of mutual attraction that prevail in a natural spring: for, to whatever theory we may incline, respecting the primary formation of the latter, we are compelled to admit, that in the product, the original causes can no longer assume any sway, and that the power of chemical attraction is inherent in matter itself. Uniformity in the peculiarities of taste, and physical properties in the natural and artificial products, are sufficient to prove this fact.

It would be altogether misplaced to object here, that chemistry, whilst presenting us, on the one hand, the ultimate constituents of many organised bodies, withholds from us, notwithstanding, the power of accomplishing their reproduction. To such a representation my reply would be, that organic chemistry is yet in his infancy; and that we are enabled, in few instances, to estimate its quantitative proportions with the same degree of certainty that unorganised bodies admit of. Still less are we provided with the means of bringing their elements into so intense a degree of contact with each other, as is attainable

in a common solution of various salts. It is, moreover, a characteristic feature of organic nature, that her creations are dependent upon the locality and disposition of the principles (arrangement des molécules.) And yet we are in possession of facts, such as the artificial production of oxalic and formic acids, of sugar, of gum, of volatile oils, &c. which allow us to hope that chemistry will, hereafter, accomplish many things which at present appear impossible.

It still remains for us to examine the merits of Berthollet's theory, in as far as it refers to the means of estimating the value of a mineral water in a therapeutical sense. According to Dr. Murray, a spring exhibiting, on analysis, the carbonates of lime, and magnesia, and common salt, would hold the lime and magnesia, regardless of the other ingredients, in the state of muriates. Thus, mineral waters, from which we obtain these earthy carbonates, in a comparatively large proportion, as, for instance, the springs of Kreutzbrunnen and Auschowitz, at Marienbad, should possess in a striking degree the medical virtues of the muriates of lime and magnesia; a circumstance which experience by no means tends to confirm.

Again, it follows, that the iron must exist in all waters as a muriate! How are we, under this impression, to account for the fact, that, on shaking up a chalybeate with atmospheric air—even though an excess of carbonic acid gas, and of muriate of soda, be present—the iron is precipitated, when we know that its muriate is equally soluble as its permuriate? Physicians are more fully aware of the different effects of muriate of iron, and of its carbonate in chalybeate waters.

Murray's theory assumes the actual ingredients to differ very materially from—Berthollet's view, on the other hand, presents them as in a great measure agreeing with,—the immediate result of analysis. And it must be confessed, that the leading tendency of a mineral spring bears a near relation to these results. The different effects of two springs (coinciding in every other particular) from the predominance of a single salt in the one,—an occurrence by no means uncommon,—is at once explained in the doctrine of Berthollet; for a change is thereby effected in the proportions of all the other salts.

The imitation of mineral springs has one more obstacle to

encounter, in the argument, that the degree of perfection at which our analyses have lately arrived, rather encourages than precludes the hopes of their further improvement. It must be confessed, that the modern and elaborate analyses of Professors Berzelius, Brandis, Steinmann, and Dr. Struve, afford a certain degree of plausibility to this objection. On, however, comparing their labours with those of experienced chemists, who preceded them, we find them to correspond in all the essential points, and the additions of the former to regard alone the detection of a few ingredients in very minute portions, and whose presence in mineral waters was never before suspected. According to the present accurate mode of instituting analyses, large quantities of water are submitted to the process at once. The weight of every single ingredient is thus ascertained by the direct method, and no longer by merely subtracting the remainder from the entire mass; and the amount of the single ingredients is yet required to agree with the sum total. Nor are the precipitates in the drain that carries off the waste water from the spring, or the fossils occurring in the vicinity of the latter, overlooked—both being submitted to a chemical examination. It is scarcely to be apprehended, that analytical research, thus conducted, and facilitated by all the resources of modern chemistry, will leave much to future detection, that can be deserving of medical regard.

Thus, reasons, both chemical and philosophical, compel us to admit, that mineral waters, prepared on scientific principles, and with the observance of an undeviating accuracy of imitation, will present us remedies, to the full as valuable as the original springs;—and recent medical experience tends amply to support such a conclusion. We might add, that they promise even a more uniform efficacy than can be looked for in many of their originals, whose constituent proportions are known, owing to atmospherical influences, to fluctuate at times. Thus, variations of this kind have even been experienced in the springs of Carlsbad and of Ems; and the baths of Töplitz, in Bohemia, have, within a period of five-and-twenty years, gradually been deprived of one-half their solid contents. Dr. Scudamore's "Chemical and Medical Report" contains observations of the same nature, relative to the waters of Tunbridge-wells, Harrow-

gate, and Cheltenham; and we may remark, that those of Seidschutz and Püllna are not considered fit for medicinal use, until they have stood long enough in their basins to become adequately impregnated with saline particles, which their taste then indicates.

The method practised in bottling artificial mineral waters, whereby decomposition is entirely obviated, is an advantage which the natural springs do not possess. With regard to a pump-room, at which mineral waters of many various kinds are dispensed, the facility of relinquishing the use of one spring in favour of another, without sacrifice either of time or expense, must be equally appreciated by the physician and the patient. A gradual transition from a weaker to a more powerful spring—even a mixture of two remote ones, a mode of treatment often attended with benefit—is thus alone rendered feasible; and where experiment is the object of the practitioner, the convenience afforded by such an establishment is too obvious to need any further remark.

Natural History of the Earwig.

INSECTS.—Class 5.—Order 1. *Coleoptera.*—Wings 2, covered by two shells, divided by a longitudinal suture.

Genus *Forficula.*—Antennæ tapering; shells abbreviated; wings folded and covered; tail forked, resembling a forceps; in each foot three joints.

Species *Auricularia.*—Earwig.—Antennæ of fourteen joints; brown; body depressed; shells tipt with white; length when full grown, eight lines.

THE Earwig is common and well known; it is rather an ugly and hostile looking insect: its very name has given it a character of dread, and, consequently, is an object for destruction, whenever or wherever met with.

This insect changes from its chrysalis state in the spring and early summer months. From heaps of garden or field rubbish, dunghills, or hot beds, they may be seen on fine warm *evenings* issuing forth in great numbers, immediately taking flight, rising to a considerable height in the air, where they disport themselves on wing till darkness sets in, when they descend and retire to hiding-places till the next evening.

At this stage of their life they are of a pale yellow colour, about four lines in length, and remarkably active and quick in their motions. Their appearance at this time, in size and colour, as well as in quickness of movement, both on wing and on foot, has induced some naturalists to consider them as a distinct species, under the designation of Forficula minor; and though further distinguished by two joints less of the antennæ, yet it is probable they are only different semblances of the same insect.

It cannot be observed how often the same individuals take their evening's flight; but as they congregate apparently from the instinctive impulse of sexual association, it is likely they only continue their flight till that important act of their being is consummated.

Throughout the summer and beginning of autumn, they are usually seen lurking in holes of walls, joints, and in crevices of wood-work, or among any dry materials. As they are the natural prey of many kinds of birds, particularly the Picæ, Gallinæ, and several of Passeres tribes, they shun the light, pass the day, if not disturbed, in their retreats, and issue forth to assemble together or feed during the night.

They are one of the greatest plagues of the gardener, for as soon as the earliest (and which is also the choicest) fruits begin to be scented, the earwigs begin their depredations, generally eating a hole either close to the stalk of pomeous, or at the apex of drupeous fruits, disfiguring, if not destroying them. Apricots are their favourite repast, and from which the spoiler abstracts almost all their value. Many guests at the dessert, and particularly ladies, have hardly courage to take a Moor park apricot on their plate, lest they should be disgusted with the sight of earwigs having possession of the cavity round the stone! Hence the gardener is ever at war with them, and especially in defending his wall fruit, for there the insects have not only safe retreats, but also "the first-fruits" to invite their voracity; and as they are midnight plunderers, he can only place reeds, and other hollow stalks of plants, to allure their entrance, and where they may be daily caught and destroyed.

Though the richest fruits seem to be preferred by them,

there are many other vegetable substances which serve them for food. The florist often has to regret the loss or laceration of some of his favourites: they eat the epidermis of stalks and leaves, sometimes the petals and stamina of the flower, and occasionally devour young plants, as those of the French marigold (tagetus patula), and others.

Throughout the summer and autumn they continue to increase in size, and in the latter season become unwieldy, and cease using their wings. The abdomen becomes much enlarged, from which circumstance they all appear to be females; this cannot, however, be ascertained, as there are no visible sexual marks in any stage of their existence; but from the habitudes of other genera in this class of insects, it is probable the males die soon after the purposes of their life is completed; and as we see the full grown ones skulking about the places where the young are resuscitated in the spring, it is likely the eggs are laid in the course of the autumn, and pass the maggot and chrysalis states during the winter.

From the weapon-like appendices at the end of the abdomen, they appear to be intended for offence, and though used for the purpose of defence, this is not the sole use of those threatening instruments, but they are the organs, without which, they could neither fold nor unfold their wings. When these are unfolded for flight, they are at least half an inch in length, and when folded lie under the protection of a shell not one-fifth of this length! The membranous and transparent wing has no tendinous or muscular motion in itself, but by the assistance and form of the forceps, they are quickly folded, like a large map in an octavo volume, with the greatest adroitness. Such provision has nature made for the disposal of appendages so necessary to the animal at one time, and for the defence of the same at another, when the pioneering habits of the insect endangers the safety of those delicate organs. Another circumstance in the structure of this loathed insect deserves remark; its safety depends on its power of secreting itself from its natural enemies, by creeping into *sinuous* holes and cavities; but this it could not do without such flexuosity of body, as its *short* shells allows; for if it had shells or elytra, covering the whole length of the

abdomen, like the greater number of the tribe, it could not enter with facility into winding holes necessary for its safety.

The name of this insect, in almost all European languages, has given it a character which causes a feeling of alarm even at the sight of it. Whether or not they ever did enter the human ear is doubtful,—that they might endeavour to do so, under the influence of fear, is more than probable; and this, perhaps, has been the origin of their name, and the universal prejudice against them. As it is said that anatomists deny the possibility of their deep or dangerous entrance into the ear, it is a pity that this is not generally known, as it might defend the constitutionally timid from unnecessary alarm, and give a more favourable idea of a part of animal creation, which forms a most necessary link in the chain of being.

While the naturalist contemplates the economy of the earwig, he cannot avoid noticing the wonderful power of instinct with which this despicable animal is endowed. In starting into active life from its dreary abode in the earth, and fitted at once to become a temporary inhabitant of the air, what but instinct opposes its not venturing forth until the evening, when the swallow and martin, and other muscivorous birds have fled the sky and retired to rest. The same unerring substitute for want of reason, directs them to shun the light of day, lest they should be exposed to view of their enemies, and they always prefer the most secret recesses of quiet and darkness, for the preservation of their existence, till the important work of securing a succession of their species is accomplished.

J. M.

The Characters of Achatinella, a new group of terrestrial Shells, with Descriptions of six Species.—By William Swainson, Esq., F.R.S., L.S. &c.

The study of the Molluscæ is attended with difficulties not to be found in any other class of animated nature. Their shells or habitations, indeed, are easily procured, and are generally the first objects with which the young naturalist begins his collection: but the living animals to which they served but as a protection, and whose structure alone can decide their place in

nature, are evanescent and perishable; defying all artificial preservation of their genuine form, and leaving the inquirer no other object to speculate upon, than an empty, inanimate covering.

It has, nevertheless, been found, in proportion as a more correct knowledge of these beings has been slowly acquired, that a general uniformity of structure in the shells of any particular group, is so frequently accompanied by a corresponding similarity of organization in the animal, that little doubt can remain of this being, with certain limitations, a general rule: and that although we may be totally ignorant of the *precise* nature of the one, yet that we are perfectly justified, by analogical reasoning, to class and arrange its shelly covering in an artificial system; waiting for that knowledge, which will hereafter give us a more accurate insight into its natural affinities.

The truth of these remarks will appear very obvious, on looking to the genus *Helix*, as it was left by Linnæus, and as it was considered only a few years back; when the French writers (who have been foremost in the necessary task of forming new divisions) still considered it only in the light of a genus, containing many hundreds of species. The illustrious Lamarck perceived the utter uselessness of such a classification; he seized upon the most prominent types of form, and at once gave them a character and a name. The peculiar views of M. Ferussac led him, in the first instance, to return to the old arrangement, so far as to consider these shells merely as a genus, divided into subgenera, sections, &c. This view, however, he seems at length to have gradually abandoned; and virtually to admit what, indeed, is quite obvious—that they constitute a family, and a very extensive one, comprising numerous minor groups, or genera, many of which rest on striking dissimilarities in their animals, and all on certain and obvious characters in the shell.

The great error which, until lately, methodists have fallen into, has been that of considering no group in the light of a genus, unless its limits, or separation from that which was supposed immediately to follow it, could be clearly defined. This notion, still very prevalent among continental naturalists, has been fast losing ground in this country, since the writings of Macleay have thrown a new light upon the economy of nature,

and struck out a path which is now followed, almost universally, by British naturalists. To characterize a new form, and to give it a name, is no longer looked upon as a dangerous innovation. Slight modifications of structure may, indeed, sometimes be mistaken for types of a superior group, and placed in a station which they may subsequently be found not entitled to. This, with our present confined knowledge, is inevitable; and if it be a real evil, it is still a very insignificant one, when put in comparison with that, which, from a system of generalizing, leads to the neglect of minute discriminations and rigorous comparison.

Without a knowledge of the animal inhabiting these shells, it is impossible to say anything on its natural affinities. Yet, so far as we can judge from the shells themselves, they appear intermediate between Lamarck's Bulimus and Achatina: between *A. fasciata* and *achatinella pica*, there is, indeed, a much closer resemblance than at first appears; yet they clearly belong to two distinct geographic groups.

ACHATINELLA.

Testa ovato-conica, spiralis. Columellæ basis truncata, incrassata. Labium internum nullum, externum internè incrassatum, margine acuto.
Habitat in Oceani Pacifici Insulis.

Shell oblong-conic, spiral. Columellæ with the base thickened and truncate. Inner lip none, outer lip internally thickened, the margin acute.
Inhabits the Islands of the Pacific Ocean.
(Generic Type. Monodonta semi-nigra Lam.) ?

The shells forming the present group are all of a small size; the largest not equalling an inch in length. In general appearance they resemble *Bulimi*, both as regards form, and the proportionate length of the spire, the principal whorl being more or less ventricose; but in some it is sufficiently short to render the shell trochiform. This circumstance, joined to the thickened and somewhat projecting base of the columella, induces me to believe, that the proposed type of the genus has been mistaken by Lamarck for a marine shell, and described, in his *Systeme*, under the name of *monadonta seminigra*. This supposition cannot, however, be verified, unless by a reference to the specimen he described. it is also rendered somewhat doubtful, as he does not quote the figures, in Dixon's Voyage round the

World, which (although I have not the book at this moment before me) accurately represent my *A. pica.* In this, as well as in all the other species, the thick and abruptly truncated base of the pillar gives it the appearance of an obtuse tooth, covered with a white enamel. The extreme margin of the outer lip is acute, but it is internally bordered by a thickened rim. These characters, in all the species I have yet seen, are strongly developed, and render this group one of the most conspicuous in the family of Helecina.

1.—*A. pica.*

A. testâ trochiformi, nigrâ; apice columellæque basi albis.

Shell trochiform, black; apex and base of the pillar white.

Monodonta, semi-nigra Lam.?

Shell $\frac{7}{10}$ths of an inch long, body whorl convex, spire conic; the three upper whorls white or fulvous, without any convexity, and forming a conic point. Suture thickened, and margined by a sulcated groove: a character that runs through all the following species, except *A. acuta.* Interior of the aperture, and base of the pillar white; the latter tinged with rose colour: margin of the outer lip within, bordered with black.

2.—*A. perversa.*

A. testâ sinistrorsâ, sub trochiformi, fuscâ faciis transversis nigricantibus lineisque longitudinalibus; apice suturâque albis.

Shell reversed, sub-trochiform, fulvous brown, with darker transverse bands, and longitudinal lines; apex and suture white.

Shell less trochiform, but somewhat larger than the last. The terminal whorls of the spire are likewise formed in the same manner; these, together with the suture, the pillar, and the aperture, are pure white. The rest of the shell is a drab coloured brown, variegated by transverse blackish bands and lines; and sometimes by others, in a waved direction, near the suture. The spiral line, which follows the suture, and the tip of the shell, both of a pure white, renders this a very elegant species.

3.—*A. acuta.*

A. testâ ovato-oblongâ, castaneâ, fasciâ marginali fulvâ; spirâ longiusculâ, apice acuto, nigro.

Shell ovate-oblong, chestnut, with a marginal fulvous band; spire somewhat lengthened, acute, the tip black.

Shell somewhat pyriform; the spire being pointed, and con-

siderably longer than the aperture. The colour is a deep reddish chestnut, the suture having a marginal band of fulvous white, but without any groove. The apex is blackish; the pillar twisted, and but slightly thickened.

4.—*A. livida.*

A. testâ sinistrorsâ, ovata, obtusâ, lividè-fuscâ; spirâ incrassatâ, suturâ fulvâ.

Shell reversed, ovate, obtuse, livid brown, spire thickened, suture fulvous.

A small, unbanded species, scarcely exceeding half an inch long, and perfectly resembling, in form, the green variety of *bulimus citrinus.* The three specimens, now before me, are reversed; varying from a light olive brown, to a livid purplish colour, which lies in longitudinal shades, and gradually changes to white on the terminal whorls of the spire; the suture is marked by a narrow band of deep fulvous: aperture white, tinged with purple.

5.—*A. bulimoïdes.*

A. testâ ovato-oblongâ, subventricosâ, albente, fasciis castaneis; spirâ incrassatâ, apice fusco.

Shell ovate oblong, sub-ventricose, whitish, with chestnut bands; spire thickened, the lip pale brown.

Larger than the last, and nearly of the same form; but the spire is less thickened, and more pointed at the apex. The ground colour, in some specimens, is pale chestnut or ferruginous, banded with darker shades, and another of pure white: in others the upper half of each whorl is whitish, and the lower chestnut, marked by darker bands: the suture is scarcely, if at all, margined by a groove; the aperture and pillar white.

Var. ?—*(rosea.)*

A. testâ sinistrorsâ, pallidè roseâ, fasciis albis obsoletis.

Shell reversed, pale rose-colour, with obsolete white bands.

I place this, for the present, as a variety of the last, to which, except in being reversed, it bears a close resemblance in size, form, and general habit. It is entirely of a pale and delicate rose colour, with two obsolete bands of white on the body whorl; the margin of the lip and columella are of a deeper rose colour, and the aperture white. It should be observed, that the marginal groove, which is scarcely perceptible in the last, is, in this, very distinct.

6.—*A. pulcherrima.*

A. testâ ovato oblongâ, sub-cylindraceâ, albâ vel flavâ, fasciis castaneis ornatis; labii margine fusco.
Var. a. aurantia, suturâ castaneâ.

Shell ovate oblong, sub-cylindrical, white or yellow, with broad bands of chestnut; margin of the lip, brown.
Var. a. golden yellow, suture chestnut.

This very elegant species is about eight-tenths of an inch long, and is much more slender than any of the preceding. It varies somewhat in form, some specimens being more ventricose than others, and also in the number and colour of its bands. The ground colour is a deep and rich chestnut, with from one to three bands of orange, yellow, fulvous, or white: the marginal groove to the suture is very close and distinct in all. The golden yellow variety is without bands: in all the colours are remarkably rich and vivid.

On the Comparative Population of the World, in Ancient and Modern Times.

(Read before the Philosophical and Literary Society of Liverpool.)
[Communicated by Mr. Merritt.]

After the masterly essay of Hume on this subject, in which the balance of evidence is so nicely adjusted, and the ultimate decision so carefully and hesitatingly pronounced, it will appear, to most persons, that the inquiry is quite exhausted. Any one who now ventures to express his dissent from the conclusions of so acute a scholar, and so accurate a reasoner, will subject himself to the danger of being heard with feelings of contemptuous distrust, and will not be expected to prove much, except his own ignorance and presumption. But on a point of this nature, where an approximation to truth is all that can be expected, no authority, however grave, must ever be permitted to arrest inquiry. Hume himself has afforded us a laudable example of what may be called ratiocinative courage, in the question now before us. Some of the highest authorities of modern times not only differ from him on this important point, but differ in so great a degree, as almost to fix a presumption of absurdity on one party or the other.

The errors of Mr. Hume are never on the side of careless

investigation or shallow observation, but the reverse. They proceed mostly from his extreme subtlety, and minute and excessive refinement. He is seldom in danger of losing himself, unless in the deep and intricate mazes of his own profundity; but occasionally, while pursuing an inquiry into its remote recesses, he is liable to overlook the obvious considerations which first present themselves. This I believe to be his vulnerable quarter in the essay in question, which assuredly, on the whole, exhibits a greater mixture of erudition and philosophy than is often brought to bear upon such a topic of discussion. In endeavouring, therefore, to show that he has overlooked, or mistaken some of the most material points at issue, I do not propose to enter into very minute details, but to offer some considerations, which, in my estimation, tend to establish a different conclusion from that to which the readers of Mr. Hume's essay are apparently conducted.

In general, I agree with him as to the extreme importance of the question, and that its decision would go far to determine the comparative value of ancient and modern governments, institutions, and manners. The philosophy of Mr. Malthus, which has obtained such general assent, strongly corroborates this assumption. If the great checks on population are vice and misery, which he is thought to have incontestably proved, it is fair to presume that where population has most flourished, vice and misery have been most effectually excluded. Mr. Malthus's theory is supported by the evidence of all history, ancient and modern. Wherever we find a fertile country, thinly inhabited, we may be quite sure that there exist some gross defects in the structure of that society, its government or institutions. The natural tendency to increase our species is so powerful, that it can only be overcome by restraints the most mischievous, oppressive, and immoral; this point, therefore, will probably afford us the fairest criterion of the actual state of that improvement in human condition, which, in modern times, has been assumed, and perhaps justly, to be always progressive. The inquiry, I am afraid, will show us, that the value of the improvement consists rather in its degree than the extent; that the diffusion of virtue and knowledge is by no means commensurate with their advancement; and that when we extol the

vast superiority of modern times, we are apt to forget on what a narrow scene this superiority is exhibited.

It is scarcely necessary to premise that in this slight survey of the comparative population of the earth, at the most flourishing periods of ancient and modern history, the inquiry will, of course, be confined entirely to the Old World. America is excluded from the question, on the old maxim of; "De non apparentibus et non existentibus eadem est ratio." It is also necessary to observe, that no attention is paid to keep separate the arguments derived, *à priori*, from the presumptions afforded by circumstances, and the proofs, *à posteriori*, deduced from the evidence of facts. A process so unphilosophical is rendered expedient in this case, as well from the cursory nature of the inquiry itself, as from the difficulty of reducing to any classification a body of evidence so vague, imperfect, and desultory.

That important and interesting branch of knowledge, so much studied of late years, under the appellation of "Statistics," appears to have attracted, in a very slight degree, the attention of the ancients. Their writers, as well as their readers, distinguished more for their genius than their love of accuracy, were generally impatient of detail, and delighted much more in devising and examining theories, than in collecting facts; hence the scattered notices afforded by the ancients, on this subject, are indirect and incidental, supplying rather hints for observation and inference, than establishing such facts as lead to positive conclusions. The Greek and Roman writers, like the French of late years, were apt to consider every country in a military point of view, and to examine its means of offence and of resistance, rather than its state of society, its produce, or occupations. Their economical writers, who have come down to us, are few and concise, and not always most attentive to those points which we are apt to regard as most interesting. This deficiency of data, while it represses, of course, all tendency to dogmatism on the part of the inquirer, renders every conclusion liable to dispute. We cannot, however, wonder that the population of the ancient world is so difficult to ascertain, when we consider that even at this time, with the exception of a few of the nations of Europe, our reasonings on this subject are founded on little more than improved conjecture.

In taking a rapid glance over the three great divisions of the ancient world, it is natural to begin with Asia, as that quarter of the globe has, in all ages, sustained the great bulk of the human species. Concerning the northern and eastern regions of ancient Asia, as we are absolutely without any information, it is useless to enter into any inquiry; it is only necessary to observe that, in the Chinese empire, every thing bears the aspect of the most remote antiquity, and the most invariable prosperity. Those articles of food, which, beyond all others, have been found capable of nourishing the greatest mass of inhabitants,—rice and maize, constituted in every age, as far as tradition can reach, the ordinary food of the people; we may take it for granted, therefore, that the population of the Chinese empire has been, at all periods, nearly stationary. The same remark may be applied to those immense tracts of land, now called Tartary, Siberia, &c.; and known to the ancients by the general appellation of Scythia. From the short notices left us by Justin, Herodotus, &c. there is no reason to believe that the condition of these countries has undergone any material change. The same general calculation may be applied to all the southern and middle districts of Africa.—Thus far, therefore, no preponderance can be assumed on either side, and the inquiry becomes narrowed within the bounds of Europe, some of the southern nations of Asia, and the countries round the Mediterranean.

Returning to the consideration of Asia, we may remark that something of a similar equality may be assumed with respect to ancient India. According to the description left us by Arrian, and the slight notices of Quintus Curtius, and others, we are warranted in concluding, from the excellence of its government and police, the mildness of its laws, and the high state of its agriculture and manufactures, that its population has not experienced, in later times, any considerable increase.

Proceeding westward, we arrive at the once flourishing and populous countries, known to the ancients by the names of Persia, Armenia, Parthia, &c.; and here the balance begins to incline to the side of antiquity with a vast preponderance. The scanty information left us by the writers of that period begins here to assume something of a more distinct and positive

character. From the narrative of Quintus Curtius, there appears to have been, at the time of Alexander's invasion, a considerable number of small monarchies, in that large tract of land between Persia and the Indus, which is, at this time, so wretchedly cultivated, and so thinly peopled. Persia itself, from the concurrent accounts of various writers, was undoubtedly one of the most flourishing, opulent, and best-inhabited kingdoms which has ever existed. Even in the infancy of that great empire, immediately after its conquest by the Medes, the army of Cyrus, on its return from a peregrination through the provinces, consisted of no less than 800,000 men; but this is nothing compared to the efforts of that powerful state at a later period. According to the statements of Herodotus, Plutarch, and Isocrates, the army with which Cyrus invaded Greece amounted to not less than five millions of souls, a number perhaps incredible, but, after making due allowances for exaggeration, that armament was assuredly prodigious. We are warranted in this belief, from the conjunction of almost every circumstance in the state of the Persian monarchy, which usually indicates an exalted pitch of power and resources. The prudent and salutary maxims of policy, ascribed to that government by Xenophon, show a high advancement in civilization, and the prevalence of that system of domestic economy, which is now understood to constitute the real wealth of nations. The division of the empire into one hundred and twenty-seven sub-governments; the splendour of these appointments; the establishment of posts, and many similar circumstances, are unequivocal signs of a highly advanced period of society. The careful cultivation of the soil was the great object pressed upon the attention of the provincial governors; and each of these officers was sure to be esteemed and encouraged in proportion to the flourishing state of agriculture in his district. When to these considerations is added the well-known fact, that, among the Persians and other Asiatics, most of the common-people and all the slaves were nourished entirely on bread or vegetables, we may conceive the multitudes of people which must have been accumulated, in a country where such perfection of domestic economy was united to such maxims of public policy.

Nothing can be more melancholy than the contrast presented by the actual state of these extensive regions. From the reports of the best modern travellers, the greatest part of Persia is at present only cultivated near the great towns, and these are far from numerous. Wandering hordes of barbarians now occupy and desolate a great part of these ancient seats of refinement and civilization.

From the western confines of Persia, to the shores of the Mediterranean, we find, in ancient times, a population of more uniform density than has perhaps ever existed in the same extent of country. The two Armenias, Mesopotamia, Chaldea, a great part of Syria, Cappadocia, and almost the whole of the Lesser Asia, abounded with large, opulent, and flourishing cities, the sure indication of a prosperous and cultivated country. According to Xenophon, the district called Asia Proper, contained above five hundred populous cities. Many of the Asiatic cities, such as Babylon, Susa, Seleucia, Antioch, Ephesus, Damascus, and others, almost vied with imperial Rome itself in the height of its grandeur. The two great rivers, Euphrates and Tigris, with their tributary streams, facilitated a constant interchange of commodities and manufactures, and diffused wealth and fertility through every province. We cannot refuse our assent to the concurrent testimony of ancient authors to these facts, when we reflect that these extensive countries constitute that part of the globe, the most visibly destined by Providence to the support of great masses of people. It has required the intervention of more than common obstacles to retard the increase of the human species in these happy regions. Throughout the whole of their vast extent, there is, at this day, scarcely a single city of any considerable magnitude. Every where the dreary spectacle presents itself of imperfect civilization, stinted industry, and magnificent ruins:—no regulated liberty; no security for property, and, consequently, few of those successful efforts in the pursuit of private gain, which constitute the ingredients of national wealth.

If we pass from Asia into Africa, the marks of deterioration are not less manifest. Ancient Egypt is believed, with great probability, to have contained a greater number of inhabitants

than any spot of equal extent on the surface of the earth. Without paying much attention to the 20,000 cities of Herodotus, or to the prodigious accounts which have come down to us of Memphis, Heliopolis, Thebes, Alexandria, &c. we have enough of credible testimony to satisfy us that Egypt, under the Ptolemies, contained at least five times the number of its present inhabitants. From the nature of the soil, and its peculiar facility of cultivation, we may be assured that this must necessarily have happened under any government of tolerable efficiency.

Even the countries at a distance from the coast, if we are to believe the account of Herodotus, were populous and flourishing. The vast territory of Ethiopia, which is now little better than a collection of hordes, appears, from several scattered notices in ancient authors, to have formerly reached a considerable advancement in wealth and civilization. This, however, cannot be much insisted upon; but we are certain that the whole northern coast of Africa, from the Isthmus of Suez to the Straits of Gibraltar, constituted an important part of the ancient civilized world. Egypt and Carthage were rivals in commerce; and the dominions of the latter power supplied the materials of a trade which has seldom been exceeded in any age or nation. We may be satisfied of this from the size and opulence of the port which was its principal emporium. The city of Carthage, at the time of the third Punic war, contained 700,000 inhabitants, and must, therefore, have been nearly equal to London, at the beginning of the late reign. A large capital is almost an invariable indication of a flourishing country, for an overgrown metropolis is incessantly fed from the abundance of the provincial population. Such a city as Carthage must have been reared by a long-continued and extensive commerce. The territory which comprised the Carthaginian dominion contained, according to Strabo, three hundred cities. That its power was of gradual growth and long duration is proved by the fact, that so early as the time of Xerxes' expedition, the Carthaginians invaded Sicily with an army of 300,000 men—a prodigious effort for any nation in its early prosperity.

The rest of the northern coast of Africa, including Mauritania, which skirted the Atlantic; Numidia, Libya, &c. comprised a

great number of powerful, wealthy, and populous nations, affluent in all the necessaries and luxuries of life, beyond most other parts of the globe, and so productive of corn, in particular, that Africa was always considered the granary of the Roman Empire. Several of those states, such as Cyrenaica, part of the ancient Libya, Mauritania, and Numidia, were strong enough to wage war, often of doubtful issue, with the mighty power of the Carthaginians; of which the naval superiority was then as conspicuous as is that of Great Britain at the present moment. No part of the world has suffered such a lamentable decay as that extensive division of Africa which leans on the Mediterranean. The whole of that vast and fertile region is now sunk to the lowest state of degradation; enchained by a domination, physical as well as moral, of so benumbing and deadly a nature, that there appears neither prospect nor hope of future amelioration—debased by its religion; depraved in morals; barbarous in manners and institutions; miserably peopled, and so imperfectly cultivated, that instead of being able to feed the south of Europe with its superfluous produce, it can barely furnish a sufficient supply for its own scanty population.

We come now to Europe; and here, it must be confessed, appearances are much more encouraging on the side of the moderns. Sweden, Denmark, and Norway, comprehending the ancient Scandinavia, and also Russia and Poland, known in different parts by the names of Scythia, Sarmatia, Sclavonia, &c. I should imagine are better inhabited at present than in former times; notwithstanding all that we are told of the prodigious swarms which issued from these dreary regions, and overspread the south like flights of locusts. When a great part of a nation changes its seats by a simultaneous movement, we cannot wonder that it assumes the appearance of an overwhelming mass. These countries have shared in the improvements, and profited by the discoveries of later ages, in such a degree, that, upon the whole, we cannot doubt that both the population and general condition are greatly advanced. Still it must be admitted, from the very nature and capacities of these countries, that this improvement cannot be such as to influence materially the general comparison.

The great strength of the argument on the side of the mo-

derns, is derived confessedly from the astonishing progress which has been made, in the three last centuries, by the nations occupying the middle regions of Europe; particularly Great Britain, France, Holland, and Germany. With respect to Great Britain, I should not suppose the difference to be by any means so great as Mr. Hume supposes. Cæsar, in speaking of the maritime parts of the island, which were probably not the best peopled, says, "Hominum est infinita multitudo, pecoris magnus numerus;" and though such general phrases are not much to be relied on, yet, when used by so correct a writer as Cæsar, who was well acquainted with all the gradations of savage and civilized life, they are not to be neglected. On the whole, however, I should be inclined to think that the British islands may contain, at present, three times the number of people which existed at the period of the Roman invasion.

Concerning France, the balance is not near so decided, nor so easily estimated. The calculations of Appian and Diodorus, with respect to ancient Gaul, it may be said, lose all authority by their extravagance. The former of these writers says that Cæsar, in the course of his wars, killed and made prisoners not less than two millions of the inhabitants of that nation. When, however, we reflect on the murderous effects of the Roman weapons and discipline among an unwarlike people, and when we consider also the enormous waste of human life, which has recently taken place in the wars of the same country, this statement will not appear incredible. But the evidence of Cæsar himself is more circumstantial and definitive. That general having received an intimation that Belgia, one only of the three divisions of ancient Gaul, was meditating a revolt against the Roman dominion, requested from his spies an exact account of the forces which the Belgians could bring into the field. The enumeration which he receives in return makes the troops of that district amount to no less than to 348,000 men. On the extreme supposition that this calculation includes every man fit to bear arms, it would show a population of nearly two millions; a number which would not be reckoned inconsiderable for a country of that extent, even in modern Europe. I mention this summary more particularly, because it is one of the most precise notices, on the subject of population, which is to be found in any ancient

author. The same writer, in speaking of Helvetia, one of the most barren districts of ancient Gaul, says expressly that the people went to war because their country was not large enough for the number of its inhabitants: "Pro *multitudine hominum*, angustas se fines habere arbitrabantur." The southern provinces of Gaul, according to Pliny, equalled in wealth and prosperity the states of Italy. From these indications we may justly infer, that the superiority of modern France, in comparison to its ancient state, is not so considerable as some have supposed.

In respect to Germany, the superiority is much more apparent. If the expression of Tacitus is to be literally understood, "Terra etsi aliquanto specie differt, in universum tamen aut silvis horrida, aut paludibus fœda," a great part of that extensive country must have been entirely without inhabitants. A little afterwards, however, he adds, "pecorum fecunda," from which it appears that it was by no means deficient in the means of subsistence. It is very certain that the strong aversion felt by the Germans to all the pursuits of regular industry, and their paramount delight in war, would greatly retard the increase of inhabitants; but on the other hand, their abstemious mode of life, the freedom of their governments, and their habits of independence, would operate in a contrary tendency. On the whole, however, the improvement of Germany is probably beyond that of any other country in the ancient world.

Throughout nearly the whole of the south of Europe, the balance, I suspect, inclines again to the other side. The Peninsula of Spain and Portugal, there is little doubt, has considerably declined from its ancient state. The valuable products of Spain, both subterraneous and agricultural, caused an immense commercial resort from all parts of the world, and the cities of Cadiz, Carthagena, and others, were among the most celebrated sea-ports of ancient times. In the time of Vespasian, Pliny enumerates three hundred and sixty cities in Spain, most of which appear to have been of considerable extent. According to Strabo, a single province of that country contained two hundred cities. This is no doubt an exaggeration; but we have abundant evidence from the accounts of its intestine wars, and the resistance opposed to the Roman conquests, that the nation was everywhere prosperous and well-peopled. Such is at

present the indolence of the inhabitants, and the inefficiency of the government, that the Peninsula is the most constant and the most extensive importer of grain in Europe. The cultivation of the soil is everywhere neglected, and the excessive prevalence of monastic institutions has tended still further to diminish the propagation of the human species.

Italy, which, at first view, seems to present the greatest facilities for comparison, is that part of Europe concerning which the controversy is attended with the greatest difficulties. The notices on this subject afforded by the Roman writers, though numerous, and given sometimes with apparent precision, are yet so perplexing and contradictory, that it is very difficult to arrive at any satisfactory conclusion. By some modern authors, ancient Rome is estimated to have contained four millions of inhabitants. Others compute its population as low as one million. Mr. Hume, on comparing the various authorities, thinks it may have contained about as many inhabitants as modern London; a calculation which appears to me, after an attentive examination, to be rather below than above the truth. Ælian enumerates eleven hundred and ninety-seven cities in Italy, but many of them were probably small towns or villages. The provincial cities, though several of them large and opulent, did not, I conceive, equal in number and size the cities of modern Italy. From every appearance, the rural population probably excelled on the contrary side. Agricultural pursuits seem to have been as fashionable among the higher classes of the ancient Romans, as they are at present in Great Britain. From the statements of Columella, as well as from the general spirit of encouragement to such pursuits, there can be no doubt that agriculture had arrived at peculiar perfection. An immense number of slaves was employed in these occupations, all of whom were nourished on a very moderate allowance of corn and vegetables only. There was little of that desolating luxury which, in modern times, appropriates so large a proportion of the earth to the production of animal food. Fish and game, as appears from the description of Horace and Juvenal, were the chief dainties of the wealthy. The middle and lower ranks, both in Italy and Greece, seem to have subsisted almost entirely on bread, vegetables, and fruit—a circumstance which, combined with the

careful cultivation of the soil, will account for their extreme abundance of inhabitants. The splendid and opulent cities which commerce and manufactures have reared in modern Italy, will not overbalance these considerations.

Ancient Greece comes next under our review, and nothing surely can be imagined more lamentable than the contrast between that illustrious nation and the countries now called Turkey in Europe. The great number of large cities, and the immense population contained in so small a space, would appear quite incredible, if we did not recollect the extreme simplicity of their mode of life, and that they received abundant and perpetual supplies from Asia, Africa, and Sicily. The assertion of the Greek historians, that Athens alone contained 31,000 freemen, and 400,000 slaves, seems generally admitted; but I should suppose that this calculation included some part of the surrounding district of Attica. Corinth, Sparta, Thebes, and several other cities, were esteemed not much inferior to Athens. Sybaris, which was never numbered among cities of the first class, sent out, on one occasion, if we may believe the historian, 100,000 fighting men, which, even on the supposition that every man fit to bear arms was mustered without exception, would lead us to infer that the place contained nearly 500,000 inhabitants. The city of Crotona supplied an army of almost equal magnitude. The various nations into which Greece was divided, contained, in fact, each a capital city; which, even after making due allowances for the national vanity of the Greek writers, appear to have been, in most instances, populous and flourishing. The more northern countries, such as Epirus, Macedonia, and Thrace, were probably not much better inhabited than the same provinces are at present. Macedonia, it is true, gave rise to the third of the four great monarchies; but the armies with which Philip subdued Greece, and Alexander conquered Asia, were raised with difficulty, and were swelled with the auxiliaries of the subjugated Greeks.

At the present moment, with the exception of Constantinople alone, there is not a single large city in the whole of these numerous provinces. Commerce and manufactures are held in little esteem, and the useful, as well as the liberal arts, are in a

state of the lowest depression. The modern improvements in agriculture, which in some places have doubled or trebled the produce of the soil, have never been able to pierce the thick gloom of Turkish ignorance and superstition. The modern Greeks, it is said, retain something of their ancient genius and vivacity, but they have sunk under a despotism which suppresses equally every motive to exertion, and every disposition to improvement.

But of all the nations of the ancient world, there is none, perhaps, which has fallen so much below its former pre-eminence, as the island of Sicily. That country not only supported a population nearly equal, in all probability, to the whole of modern Turkey in Europe, but furnished large supplies of grain and provisions to Italy, Spain, and Greece. From the statement of Diogenes Laertius, the single city of Agrigentum contained not less than 800,000 people; a number not much inferior to the present inhabitants of the whole island. Syracuse was, at one time, esteemed the largest of all the Greek cities, and, at least, equal to Agrigentum. The smaller cities, towns, and villages were almost innumerable. On the other hand, the city of Palermo, the modern capital of Sicily, and almost the only town in the island of considerable size, contains little more than 100,000 inhabitants. Many districts of the country, which, in ancient times, there is reason to believe, were cultivated like a garden, are now almost in a state of nature. This island alone, in its former state, is a striking proof that the modern improvements in agriculture are not, as some have supposed, essential to the production and support of an excessive population.

Such, as it appears to me, is the faint but visible outline of the comparative numbers of the human race, in the ancient and modern worlds. In this cursory survey, it is not assumed that any very near approximation to the truth can often be obtained; far less, that accurate calculation can in any instance be exhibited. Nor is this at all a matter of surprise. Even at the present day, when the science of statistics is more studied and better understood than at any former period, it is only in a very few countries of Europe, that the inhabitants have been exactly numbered. In ancient times, it is well

known, the subject occupied, in a very slight degree, the attention either of their legislators or philosophers. Though literature, as well as all the liberal and elegant arts were then advanced to their point of highest perfection, the exacter sciences were, with a few exceptions, very loosely and imperfectly cultivated. It is true, a census of the citizens of ancient Rome was periodically taken and regularly published; but as this was done chiefly for military purposes, it affords no sufficient data for estimating the entire population of the country. The facts and circumstances which have been enumerated, are, however, for the most part, sufficiently conclusive; and they are, in general, such alone as we can ever hope to obtain in our reasonings on this important subject. That Ireland, for example, is a more populous country than Livonia, is a point ascertained by unquestionable indications, though the inhabitants of these two nations have never yet been accurately numbered. On such subjects we have only to rest contented with the best evidence which can be afforded by the nature of the case.

From the evidence then, such as it is, which has just been produced, I think it is sufficiently manifest, that two, at least, of the three great quarters of the ancient world, have been materially depopulated since the Christian era. Without assenting to the extravagant speculations of Vossius, Montesquieu, and other writers of very grave authority, who have been visibly misled by their predilection for ancient times, a great decrease in the numbers of the human species is but too apparent. That vast portion of the globe, which is furnished with the most abundant resources for the enjoyment and propagation of life, where nature annually pours forth, in profusion, her double and three-fold harvests, and where myriads might be maintained with the toil of a few,—that richest and fairest part of the earth is now a comparative desert. In the whole of that immense tract which stretches from the Straits of Gibraltar, through Northern Africa to the Indus, the great seat of ancient civilization, commerce, and population, there is scarcely a single city of the first order; not a single province which is fully inhabited; not one district which is perfectly cultivated. The subjects of the Roman empire are estimated by M. Gibbon, on a very loose calculation, it must be admitted, at 120

millions. The latest and best authorities do not reckon the whole inhabitants of the Turkish dominions at more than 18 millions. Yet this monarchy comprises the largest, the most opulent, and populous districts of the empire of the Cæsars, with many countries to which the Roman sway never extended.

It is true that, in some parts of the world, an improvement even more striking than this immense deterioration has visibly taken place; but it is plain that there is nothing which approaches to compensation. In the two largest divisions of the Old World there is perhaps scarcely a single nation which has experienced any considerable increase. Northern Europe, undoubtedly, has augmented in its population to a very great degree, but it is not less evident that the nations of the South have, for the most part, declined: not perhaps in the same proportion, but yet so considerably as to afford, upon the balance, no sort of compensation for the dreadful decay of Asia and Africa. The improvements, though great, are unhappily on a small scale: the decline is not only excessive in its degree, but enormous in its extent.

Here it will naturally be suggested, that there must have been some great and permanent causes uniformly operating to produce this constant decay of the human race through the lapse of so many ages. If such an inquiry should be made, it would not be very easy to give any satisfactory answer. Every sudden and marked improvement in the condition of any people may commonly be ascribed to visible and positive causes, but a state of stagnation, or of gradual decline, is so much in the course of human affairs, that it seldom excites investigation. It may be sufficiently explained by the natural *vis inertiæ* of man when placed in a situation that leaves untouched all the great springs of human activity. Some external impulse is commonly required to set forward a nation in the career of amelioration. This holds particularly true with respect to those regions of the earth, the most favoured by nature with a benignant climate and a fertile soil. A nation thus circumstanced, when once depressed, will continue for ages without a single effort to rise from its degradation.

The more immediate causes, however, of this long and profound debasement, and consequent depopulation, of the

fairest parts of the habitable globe, are sufficiently obvious. Throughout the whole of these vast regions, it is well known, there prevails an almost total ignorance of all the arts of civilization, and a systematic contempt of all sound principles of government. If a more remote cause is sought for, it may easily be found in that entire subjugation of all the best faculties of the mind and body, which has been effected by the Mahometan superstition, engrafted on Turkish barbarism. I consider this as the most enormous and the most pernicious nuisance which has ever been set up against the happiness of mankind, and one which, at almost any price, ought, if possible, to be abated. Nearly all the institutions of that religion; its rites and observances; its toleration of polygamy; its encouragement of monastic orders; but above all, the spirit of despotism which it inculcates, tend directly to the diminution of the human species. An abject, and often an inhuman slavery, mental and corporeal, is diffused through every class of society. The autocracy of the monarch is not more absolute than the domination of his meanest subject, who has acquired the right of subjugating to his will a few unhappy beings more depressed than himself. As the laws are generally inefficient where liberty is unknown, there is, of course, no security for property, and, therefore, no incentives to industry, and no hope of independence. The visible plan of Providence in the association of the sexes is wholly frustrated. A rich voluptuary, exhausted by years and excesses, can take as many wives and concubines as he thinks proper, and as these are all rigorously confined, they are of course condemned to perpetual barrenness. A poor man, though disposed to regularity, and capacitated for rearing a family, is commonly deprived, by such monstrous appropriations, of the power of taking a wife; and in any case can have little hope of providing for his children. It is not surprising that, under such circumstances, the finest countries in the world should exhibit all the symptoms of sterility and decay.

The only chance of deliverance from this desolating evil which has presented itself in later times, arose from the French invasion of Egypt in 1799. That enterprise was assuredly undertaken solely from views of ambition, and, probably, with some ultimate designs on the British empire in India. It is also pos-

sible that if the French had finally succeeded in their attempt, its only effect, on the Oriental and African nations, would have been the exchange of one species of despotism for another. There is, however, a great difference between an ignorant and an enlightened tyranny. The French expedition was accompanied by men skilled in every department of knowledge, and, if they had been permitted to remain, some beam of light from these luminaries of science must have radiated in every direction. But that eternal obstacle to the civilization of Asia and Africa, the mutual jealousy of the powers of Europe, interposed its influence, and all the possible consequences of this extraordinary scheme were in a moment rendered abortive. As citizens of the world, we cannot but lament the interference, though it is not to be condemned on the principles of sound European policy. It may be urged, that even if the French invasion had produced the happy effect of introducing the arts and refinements of Europe into the East, these gifts would have been presented at the point of the sword. Such would, most probably, have been the case; but it may be doubted whether even the horrors of war and conquest be not a happy exchange for the mournful repose of slavery. The fetters which bind these unfortunate countries are too strong to be shaken off without a violent concussion.

After what has been said, it is scarcely necessary to remark the fallacy with which Mr. Hume concludes his argument: "Upon the whole," says he, "it seems impossible to assign any just reason why the world should have been more populous in ancient than in modern times. The equality of property among the ancients; liberty, and the small division of their states, were indeed circumstances favourable to the propagation of mankind. But their wars were more bloody and destructive; their governments more factious and unsettled; commerce and manufactures more feeble and languishing; and the general police more loose and irregular." This summary conclusion may be answered in the same style; for some of his premises are plainly false, and others inconclusive. In those regions of the earth which were the great scenes of ancient population, the governments were *not* more factious and unsettled; commerce was *not* more feeble and languishing; and the general police was *not* more loose and irregular. The comparison is only valid, as be-

tween the nations of ancient times and the countries of modern Europe. Between the former and present state of Asia and Africa, every parallel is in favour of antiquity. That the ancient wars were more bloody and destructive, must indeed be admitted; but this makes very little for the general argument. It is found by repeated experience that population advances to its habitual standard, after any casual waste, with surprising rapidity. A permanent decline can only be produced by the influence of causes which uniformly operate.

If then, as was observed in the beginning of these remarks, the progress of nations in the arts of wisdom and happiness is usually concomitant with the increase of their people, we are forced upon a conclusion of a very saddening aspect. At first sight we should be induced almost to despair of the fortunes of the human race. The sanguine speculations of philosophers, it would appear, have, thus far, proved illusory, and instantly sink before the sober contemplation of facts. From the rapid march of a few countries, in a remote corner of the world, in science and humanity, we are apt to receive an impression that the human race has reached an advanced post beyond all the attainments of former ages.

Assuredly our exultation has begun too soon, but there is, however, little to appal, and much to cheer us in the prospect of the future. The great discoveries and inventions of modern times, which have given to some parts of Europe such an immense superiority over all other ages and nations, and which secure us for ever from the return of barbarism, are yet in the first stage of their operation. Every thing will be accomplished in the fulness of time. The machine which is to raise the world has found a fulcrum, and though, like the mechanical powers, it may lose in time what it gains in force, its work is steady and unintermitting. The tyranny of ignorance and prejudice is not easily broken, but we may be satisfied that its overthrow is progressive and ultimately inevitable.

An Account of a new Genus of Plants, named Macræa.—By John Lindley, Esq., F.R.S., &c. &c.

In the number of this Journal for January, 1827, will be found some remarks upon the orchideous plants of Chili, founded upon an examination of a large herbarium, from that country, in the possession of the Horticultural Society. From the same rich mine I have now selected a small set of unpublished plants, both on account of their intrinsic singularity of structure, and also for the sake of commemorating the deserts of the excellent collector by whom they were first discovered.

The plants, which are the subject of the following observations, are small arid shrubs, natives of high land, in the interior of the western side of South America. Their leaves are opposite, without stipulæ, beneath glandular, and densely covered with very thick tomentum. The flowers are axillary and terminal; the calyx five-toothed, and strongly ribbed; the petals unguiculate, persistent, and unfading; the stamens hypogynous, and twice the number of the petals; the ovarium superior, three-celled, with two ovula in each cell, one of which is ascending, the other suspended from a small common placenta in the middle of the axis; and the stigmata are three. The capsule is enveloped in the persistent calyx and petals, and divides half way into three loculicidal valves, which separate from the axis. The seeds are unknown.

Such are the most prominent features in the structure of the three known species of Macræa, the characters of which it will be convenient to define, before any attempt is made to determine what affinity they bear to other plants already known to botanists.

MACRÆA.

Calyx inferus campanulatus 5-dentatus, costis cuique laciniæ tribus quarum duæ marginales sub sinu confluentes. *Petala* 5, toro brevi inserta, unguiculata, arida, persistentia, immutata, æstivatione contortiva. *Stamina* 10, apici tori brevis inserta; *filamenta* filiformia; *antheræ* innatæ anticæ biloculares longitudinaliter dehiscentes. *Ovarium* superum triloculare; *ovula* cuique loculo duo: altero ascendente, altero suspenso; *placenta* parva in medio ovario ad basin axeos. *Stylus* brevis; *stigmata* tria, linearia marginibus reflexis. *Capsula* vestita papyracea 3-locularis semitrivalvis; valvis loculicidis ab axi secedentibus usque ad placentam. *Semina* . . . . Suffrutices *aridæ* (Chilenses). Folia *opposita, exstipulata, pube simplici, subtus lanata.* Petala *alba, v. rosea.*

1.—M. *grandifolia;* foliis subtus griseis glandulosis: venis prominentibus, ramis pubescentibus, pedunculis foliis brevioribus.

Sponte crescentem juxta vicum *Colina*, urbis *Santiago* finitimum legit M'Rae, 1825 (v. s. sp.)

2.—M. *parvifolia;* foliis subtus niveis glandulosis: venis obscuris, ramis arachnoideis, pedunculis folio brevioribus.

Cum præcedente legit M'Rae (v. s. sp.)

3.—M. *rosea;* foliis distantibus subtus niveis eglandulosis, ramis pubescentibus, pedunculis elongatis.

Ad *Cumbre*, Andium claustrum, Novembre floridam legit M'Rae (v. s. sp.)

In the absence of information respecting the structure of the seeds of Macræa, it is not practicable to arrive at any certainty as to its affinity. Its structure, indeed, is so peculiar, that it may be doubted whether, even with the seeds before us, its station, in a natural system, would be positively determined.

In many circumstances it bears much resemblance to Caryophylleæ, with which it agrees in its opposite leaves, terminal and axillary flowers, five-toothed monophyllous calyx, unguiculate petals, with a twisted æstivation, and stamens inserted into a torus; but it is at variance with the whole order in habit, single style, and trilocular oligospermous capsule, the valves of which separate from the axis. With Lineæ it has nearly the same points of resemblance and difference.

To Cistineæ it has a striking resemblance, in the nerves of its calyx, which are remarkable, and also in the variation of its opposite exstipulate leaves: its anthers have also a similar insertion; but the monophyllous calyx, unfading petals, definite stamens inserted on a torus, and three-parted stigma, are all at variance with the essential diagnostics of Cistineæ.

With Frankeniaceæ, Macræa agrees, in having a monophyllous ribbed calyx, and arid habit, and also in several other points of structure; and with this order I was at one time disposed to place it, but a further consideration of the great difference between their fruit has led me to abandon that opinion, especially upon a consideration that the similarity, supposed to exist in the ribbing of their calyx, is more apparent than real. In all the species of Frankenia that I have examined there have been, to each division of the calyx, two collateral broad costæ placed on each side of the axis, which, therefore, as well as the space between the sinuses and base of the calyx, was ribless. But, in Macræa, on the contrary, each division

of the calyx has three costæ, one occupying the axis, and one running along each margin, and becoming confluent beneath the sinuses. In Frankenia, therefore, the costæ of the calyx occupy the place of the intervenia of Macræa.

Having thus instituted comparisons with those orders, to which Macræa bears the greatest apparent resemblance, I must next proceed to advert to another natural assemblage, to which it offers, indeed, no *primâ facie* characters of affinity, but near which it is, nevertheless, probable that it will ultimately be arranged; the order to which I now allude, is Geraniaceæ. It is true, that the elastic coccus, the lobed leaves, the succulent habit, and thickened joints, of Geraniaceæ, are all absent in Macræa, as well as a number of subordinate points of structure; but there are others in which they remarkably agree. If we understand the axis of the capsule of Macræa to be an elongated torus analogous to that of Geraniaceæ, and such an opinion may be entertained with little difficulty, we have then a fruit of a sufficiently similar structure to be compared to that of Geraniaceæ, Rutaceæ, and other neighbouring tribes. In the venation of the calyx there is also so material a similarity, that if the distinct sepals of Geraniaceæ were to cohere for half their length, thus losing their membranous margin, we should have a calyx little different from that of Macræa. The petals of both have the same æstivation, are equally unguiculate, and their principal veins, in like manner, bend inwards, and become confluent with each other within the margin. The stigmas also are several, and the insertion of antheræ is not materially different.

For these reasons it may be concluded, in the absence of more complete evidence, that the affinity of Macræa is far from close with any of the known orders of plants; that it probably occupies an intermediate place between those whose fruit is destitute of axis, as Frankeniaceæ and others, and those whose fruit consists of carpella, adhering to an elongated axile torus, as Rutaceæ, Geraniaceæ, &c., and that its greatest apparent relation is with these last.

On the comparative Merits of the new refracting, reflecting, and single Microscopes; with a Vindication of Microscopic Science, and its Votaries. By C. R. Goring, M. D.

[Communicated by the Author.]

Refracting and reflecting microscopes do not stand in the same relation to each other that telescopes of similar construction do, though it is true that the ratio of their natural illuminating power and light is not very different: the light of the Amician microscope is equivalent to that of the Newtonian telescope, (if we do not reckon the quantity lost by the interposition of the small diagonal metal, which from its larger proportional diameter amounting to about one-third of the aperture of the elliptic one, is much more considerable in the microscope than in the telescope.)

The light of the Newtonian construction is said to be in the ratio of 5^2 to 8^2, or perhaps 7^2, compared with that of an achromatic object-glass of the same aperture; but the small metal in the microscope causes a greater loss, and perhaps reduces its light to the ratio of only 5^2 to 8^2, or even 9^2, compared with that of a refractor of the same calibre. This difference would make a very serious defalcation in the performance of a telescope, but it by no means operates in the same manner on a microscope, for reasons I have frequently alluded to, *viz.*, because we can brighten a microscopic object artificially, and thus compensate for almost any mere loss of light. Moreover it has always appeared to me, nay I believe it may be positively demonstrated, that *a certain perfect angle of aperture is exactly as penetrating and effectual in metal as in glass*, exhibiting all the objects within its reach, even if no care is taken to compensate the want of light by artificial illumination; the only difference seems to be, that the picture of the reflector is much darker than that of the refractor, but equally developed and evident.

To this issue, therefore, I think the case between the two kinds of microscopes may be committed. There are, however, other circumstances which require discussion. The depth of the curves of the small aplanatic lenses precludes the extension of the aperture, of the best triple ones, beyond a certain point; whereas that of the metals may be carried a great deal

further from the shallowness of their curves: it follows therefore, *that if a certain angle of aperture is just as effective and valuable in the one as in the other*, the reflector must inevitably have the advantage over any *single* achromatic, at all events, with those objects which require a very large one, and accordingly this is found by experience to be the case. Thus the lines on the feathers on the wing of the Papilio Brassicæ, which are at best but barely visible with the single 0.3 achromatics, with an aperture of 0.15 are most distinctly and satisfactorily demonstrated by the 0.3 focus metals with an aperture of 0.2: the same may be said of the interlaced lines and lozenges on the scales of the Podura, that most valuable object lately discovered by Mr. T. Carpenter.

Opticians have lately been diligently exercising their powers in stringing object-glasses together—instead of getting their power and aperture in one glass, they obtain it bit by bit in detached portions. This practice has been carried much too far, but it must be confessed that *when two objectives are combined together in a fitting manner*, they tread very closely on the heels of a reflector in most respects, and fully rival it in dulness and darkness, from the multiplicity of the refractions employed, though by no means in the singleness and simplicity of their optical operation. Two triple aplanatics or three double ones combined, give, I think, as dark an image as a reflector of the same angle of aperture; in addition to which there is a want of clearness and vivacity in the picture which certainly cannot be laid to the charge of that of a good reflector. It is a known fact that errors by reflection are six times greater than those by refraction; but if we have twelve curved surfaces to manage in a glass microscope, its errors will be most probably about equal to those of a catadioptric constituted by two reverberations like that of Professor Amici. Those who know how to put optical instruments out of focus, and look into their defects, will be able to estimate more nicely the distinctions between reflectors and refractors both single and composite: for my own part I think it an indisputable fact, that no *single* achromatic can be put in competition with a reflector, (setting aside the secondary spectrum, always incorrigible by the best arrangements,) *unless the apertures employed in both are*

very small. It is curious to see how the aberration of a single object-glass varies with different angles of apertures: a good triple 0.9 focus will, with an aperture of only 0.2, incline to have its spherical aberration in the convex, with 0.35 it will be about correct with 0.4, the spherical aberration will incline towards the concave, and with 0.5 it will be very overpowering in the concave.

If two are combined, *which both work well in a detached state*, the same state of aberration still continues, though with diminished effect. It is only when the anterior object-glass *is made expressly to correct the other*, and to be useless by itself, that we get an approximation to that perfection in figure which it is always practicable but difficult to give to metallic surfaces.

" A metal of 0.6 focus with 0.3 of aperture, or any other focus with the same angular opening, I have frequently seen so figured as to be quite perfect, showing, when put out of focus, no tendency either to sphericity or parabolism, but a true and genuine elliptic curve, giving with a low power that *intensiva* of distinctness which in my opinion will never be obtained from any refracting instrument, however excellent. Simplicity must, I think, ever be held to be a capital ingredient in the perfection of works of art; and nothing can be more simple than the operation of a reflecting instrument, or more complicated than those of a thick sextuple or double triple aplanatic object-glass of large aperture, for diverging rays: there is perhaps not a mathematician in Europe who dares to face the theory of it. It has always been an admitted fact, that reflecting telescopes would beat refractors, was it not for their want of light; but it has been shown, I think, that in reflecting microscopes this defect is of little or no practical consequence. There is an object which I have never yet seen satisfactorily with a refractor, *viz.*, the cross striæ on the feathers of the Papilio Brassicæ and some others of that class; whereas a reflector of 0.3 focus and 0.2 of apertures brings them completely out either by daylight or lamp-light in their full complement, and by the former allumination so as to be visible *along with the longitudinal lines*, presenting the appearance of a piece of brick-work.

The radiant point in the Amician microscope approximates

so closely to the side of the tube containing the metals, as to prevent the artificial illumination from being thrown down upon opaque objects, so as to be returned at a sharp angle, unless we employ silver cups, with which they are a match for any object requiring this sort of light, such as the fly's foot, &c. All those opaque objects which require an oblique radiance, such as the whole family of lines, are shown decidedly better by the reflectors than the refractors. The 0.3 focus metals with 0.2 aperture, allow just room enough for this kind of illumination, and exhibit this class of bodies in a style which no glass microscope will, I think, ever be able to surpass or even equal. In short, where is the object which a good Amician cannot show in the best possible manner?* it has, however, one imperfection, which renders it a disagreeable instrument for giving a general view of objects, *viz.* it will not give a very low power without a contracted field of view, with a nebulosity in the middle of it; whereas the achromatics are not subject to any such inconvenience: the superiority, therefore, *with very low powers*, must be conceded to them. Both of these valuable instruments have their separate utilities and applications, and I think it may be asserted, without disparagement to either, that each possesses the properties which the other is deficient in. Those who have not seen transparent objects with a good reflector, cannot well form an idea of the effect produced by the total absence of all coloured fringes, more especially, perhaps, on very delicate animalculæ. In the best achromatics there is always a tinge of colour left by the secondary spectrum, (though I must say that my 0.2 object-glass approaches very nearly to the perfection of a reflector in this point.) If, in addition to the total absence of chromatic dispersion, a perfect figure has been given to the metals caused to correct along with truly achromatic eye-pieces, upon the same principle that the hyperbolical aberration of the large metal in a Gregorian telescope is made to counteract the spherical error of the small one,

* In Vol. i, No. 11, of *Gill's Technological Repository*, August 1827, Art. 22, "On a difficult test object for the Microscope," is contained an underhand insinuation, calculated to produce an impression to the mind of the reader, that the Amician microscope will not show the minute hairs on the larva of a dermestes. I must state that the said hairs are *scarcely worthy to be called test objects*, being far more easy than bat's hairs, and demonstrable by *any* microscope; *the two inch metals* of the Amician show them perfectly well.

together with that of the eye-pieces, the vision may be considered, (barring the circumstance of viewing an image, instead of its real prototype) as mathematically correct, which that of a refractor never can be, for spherical aberration can be *perfectly* corrected by the concave of the aplanatics only, to *small angles of aperture*, scarce sufficient for practical purposes. The superior natural brilliancy of *single* achromatics, with any given angle of aperture, though not absolutely requisite to render objects evident, yet cannot fail to strike the most careless observer, rendering the picture on the retina much more pleasing and satisfactory: this is another point of superiority which I willingly concede to the refractors. Again, though the catadioptric microscope is more perfect in its principle, and susceptible also of more perfect execution than the achromatics, yet to the refractors must be conceded all those advantages which are included under the head of *conveniences* and *accommodations for observations* in working tools. It must, I think, be quite needless to insist on this point. How are we to view an object in the bottom of a cavity with the Amician microscope, which, perhaps, has not more than 0.1 of an inch of distance between the tube and the object to be viewed? How can we examine objects contained in a jar of water or other fluid at a considerable depth below the surface? How are we to find room for managing our tools if we mount it with an erecting eyepiece for dissection, &c. There is still another point which I had nearly forgotten, the image of the reflector being many degrees darker than that of a refractor, *cæteris paribus*, it must follow that there will be a power at which it will cease to be visible, from mere faintness and dulness, when the superior light of the refractor will still be enabled to affect the retina; and this will take place at last under the most vivid artificial illumination which can be procured.

I however deliver it as my opinion that such extremities will never occur *with any useful working power*; an Amician is capable of showing an opaque object completely well, with a power equal to that of a single lens of $\frac{1}{40}$ inch focus; (which I can state from my own experience, to be enough for any opaque object I ever met with) on transparent bodies, it will go up to $\frac{1}{60}$ or even $\frac{1}{80}$.

I have thus (though I am afraid in a very ill arranged and rambling way) stated the different essential virtues and capacities of refractors and reflectors, according to my own ideas; it remains for me to compare the compound instruments with the single ones, and the subject will be exhausted: this I have, in fact, in a great degree, done in a note on Mr A. Pritchard's paper on diamond lenses; so that it will not be requisite for me to give more than a slight recapitulation of what I have there advanced, with a few remarks on the action of the aplanatics used as single microscopes.

The aberration of ordinary lenses is not thoroughly displayed until they are caused to form a picture; when we merely use them as a medium to enable us to view objects under large angles, they operate reasonably well, never producing indistinctness enough to preclude the vision of anything they ought to show, though they may veil it in a disagreeable vapour of scattered light, and fringe it with prismatic tints. On this account there is not a difference between the performance of achromatics and common lenses, used as single microscopes, proportional to that which they exhibit as object lenses. On a former occasion I have remarked, that the figure of an aplanatic intended to be employed as an object glass, is different from what is required for a mere magnifier. To the latter purpose, however, their curves might be adapted, and we should then arrive at the extreme intensity of distinctness in viewing a real object. As however usually made, if a sufficient reduction of their aperture is effected, their performance is faultless. Nothing can be more beautiful than the action of an achromatic of about an inch focus *used with any aperture* (for the iris is sure to reduce it sufficiently); the *shorter foci of course must be cut off*, otherwise their false marginal rays will be able to clear the opening in the curtain of the eye—I do not think we shall ever have any single achromatics of shorter focis than about 0.2 inch, a power which is capable of doing a vast deal of useful labour, as indeed an inch focus will also.

What we want in microscopes, and what we should boast of, *is to be able to see everything with very low powers.* It is astonishing when we really go to work with *good* microscopes at investigating nature, how seldom it is necessary to use a high

degree of amplification. Where the power of the achromatics terminate, we must be content to begin with that of sapphires and diamonds, (precious stones indeed to the optician and naturalist.) As the depth of single lenses is increased, of course their aperture becomes proportionally reduced, and at a certain power gives a cylinder of rays so small that the impression which its light produces on the retina is very faint and diluted; this causes their aberration, though still as considerable in proportion to their solar foci, as in the largest glasses, to become as weak and insensible (with regard to our visual perception, at least) as their light is; for the manifestation of aberration, depends on the quantity of rays acted upon, so that a diamond or sapphire lens of about $\frac{1}{20}$ inch focus, will show no more aberration than an aplanatic of 0·2 inch, and is equally fit for practical purposes. The new single microscope, therefore, may be said, *with certain powers*, to have as much superiority over the common glass ones, as the new compounds have over the common rubbish of commerce. Their relation, therefore, to the new refractors and reflectors, also continues about the same as usual, and may be at once comprehended when we consider that the single instruments show the veritable object without aberration, and the compounds an image without aberration.

I have delivered it as my opinion in the note on Mr. Pritchard's paper already alluded to, that the new compounds, (when their power is not forced beyond that of $\frac{1}{20}$ of an inch) beat common single microscopes, but of course *not achromatics used as single magnifiers;* this would be a contradiction. *There however will be an hiatus* to be filled up in the single microscope, between the termination of the achromatics at 0·2 focus, and the beginning of the sapphires and diamonds at about* $\frac{1}{20}$, for to this depth I think they must come, to render their aberration faint enough to cause their performance to compete with that of the aplanatics. The compounds must,

* This gap may, perhaps, be closed, and the whole range of power rendered equally perfect, by a set of compound magnifiers of Mr. Herschel's construction, consisting of a meniscus combined with a crossed lens, having the curves calculated for and executed in sapphire. This composition executed in glass only, is very superior in performance, and would nearly rival the achromatics, did the chromatic dispersion admit of correction.

therefore, ever remain of the highest value; for it will be recollected that if their *forte* does not extend beyond powers ranging as far as the $\frac{1}{20}$ inch, that in this scale all the working powers are included. The deepest single lens among those employed by Leeuenhoek, was of no shorter focus, and with this he saw more than ever was seen before his time, or ever will be seen again, with all our boasted improvements.

When we come to powers exceeding the $\frac{1}{20}$ inch, the single miscroscope comes into full effect, and carries us on till all certain vision fades away into obscurity, and the strain upon the eye in finding the object and adjusting the focus becomes no longer tolerable: there can be no doubt that powers of $\frac{1}{60}$ and $\frac{1}{80}$ inch (to the use of which the eye may be familiarized) enable us to look more closely, more narrowly, more deeply, and more certainly, into the texture of highly-finished objects, than any equal powers of the compounds.

It may not be taken amiss if I here give my advice concerning the particular sort of microscope best adapted for any given purpose; for, as I have been the main agitator by whose influence and exertions the new microscopes have been brought into use, I cannot be suspected of undue partiality towards any of them. First, then, is your purpose *merely amusement* for yourself and friends, without having any particular object in view? Will you be content to see what has been seen before your time, without attempting to discover any thing yourself, or to rectify the discoveries of others? get an achromatic, and view *large objects* with *low powers;* two object-glasses, one of two inches focus, and another of one inch, will be quite sufficient. Any attempt to show small difficult objects with high powers, to individuals unused to microscopes, is sure to miscarry. The peripatetic microscopists in the streets, and public exhibitors, know this full well; they always show large objects with low powers, and then put their disciples into extacies, by telling them that they are looking at very minute objects with very high powers. The *οἱ πολλοι* moreover are never pleased unless they can see the *whole* of their object; they must likewise have every mathematical point about it in the focus *at once*, no matter how uneven or irregular it may be.

Nothing irritates them more than the stubbornness and inflexibility of the laws of optics in this respect; if they view a drawing of an object, a fly's foot for example, they of course see every thing about it represented as when in focus, how else can it be drawn? Yet not more than a point can be seen at once in an instrument having the power to develope its high and exquisite finishing: if the drawing is accurate say they, why does not the microscope show us all these minutiæ at once as they are represented? It is vain and useless to contend or explain with people of this way of thinking; microscopes are not made for them. A solar achromatic is of all instruments that most adapted to popular taste: it gives no trouble whatever to the observer, and is sure to take with most, especially if used with live objects, (invariably those exciting the highest interest in ordinary minds.) What a sublime spectacle to see a battle between voracious aquatic insects, terminating in a verification of that great law of nature, eat and be eaten! Bets may be laid, and every particular round described in scientific slang. I have recommended achromatics for these purposes, but I must confess that the appetites of uncultivated amateurs are so gross, their eyes generally so dull, and their powers of investigating the performance of an instrument so feeble, that the most common and ordinary constructions show them every thing they care about seeing, quite as well as they wish to see it.

Again, if we want a regular working tool for drawing and dissection, (especially if this operation is to be carried on under the surface of a liquid, which is frequently a most useful mode of proceeding,) recourse will naturally be had to the achromatics. The peculiar advantages of refractors as real operative instruments, have on so many occasions been detailed by me, that a recurrence to the subject here would be quite a work of supererogation. Moreover, it is not to be supposed that I impugn or in any manner pretend to derogate from the merits of refractors, when applied to *any* purpose. The deeper their objective part can be made, consistent with perfection, the greater will be the power at which they are capable of arriving, preserving all the while that admirable clearness, beauty, and truth in vision, with which they set out in the commencement of their scale of amplifying power.

Regular men of science and real connoisseurs in the vision of curious and difficult objects, will, I think, admit, that the improved Amician reflectors will ever maintain their ground, and remain at a proud level among microscopes. I have no doubt that they will descend to posterity as a valuable legacy pretty much in their present form, nor do I think they will ever be superseded by other catadioptric constructions. I recommend them to all those who admire a compact, scientific, portable, and most effective instrument, without desiring an absolute working-tool*, or low powers to show large common objects—(for the Amicians will not afford to come lower than one quarter of an inch.) The optical superiority of the reflecting principle I have so largely dwelt upon in the commencement of this paper, that I trust it will already have produced a due and just impression on the minds of my reader. I have myself that kind of *perfect satisfaction* in looking into a really exquisite reflector, which I never experience with any other compound instrument.

To the good old-fashioned single microscope pertains all those advantages which result from extreme portability and compactness; it may be squeezed into the size of a snuff-box if requisite: it must ever recommend itself, and maintain its ground as a most useful working-tool for dissection, &c., with low powers. Whenever we are at a loss with the compounds, as to whether we do or do not see some particular object, it will always be highly advisable to verify with a single lens. To the purpose of *verification*, the high powers of the single microscope will be eternally applicable; the naturalist must ever respect it as the most tried and faithful of servants, and the most valuable appendage to the compounds. Did I myself wish to go over the ground of other observers, to correct their views, to see more than had been seen by them, and to push my researches into the extreme penetralia of nature, I should certainly attempt these objects by means of the deepest single lenses of adamant and sapphire, which I could obtain or use. On the inaptitude of the single microscope to particular purposes, I

* It must not be forgotten that Mr. Cuthbert has adapted the stand and apparatus of the Amician reflector, to an achromatic as well as a single microscope, so that it combines the properties of the three instruments.

have had occasion to insist so frequently in former papers, that I conceive any recurrence to such topics must be here wholly superfluous.

I here cannot withstand the inviting opportunity which presents itself, of winding up this paper with a word or two concerning the *intrinsic* merits of microscopes, which many individuals have lately been pleased to assert have been set up much too high, and have reached a level in the estimation of men of science to which they are not legitimately entitled. It has always been customary to vilify microscopes and those who use them, as if all microscopical discoveries were at the best useless, frivolous, and utterly unprofitable. Dissector of blackguard vermin, observer of a drop of stinking ditch-water, or of the amorous passions of worms and ants, *&c.*, are certainly terms which convey anything but an exalted or even respectable idea of a man's character and occupation; and if microscopes could be applied to no other purposes, I should be apt to think myself that a microscopist was but a puny, pitiful pedant, whose passions and amusements were of a childish and even degrading complexion. But I would ask whether a microscope in the hands of men like Bauer is *not applied to high and important purposes*, elucidating the most curious and delicate points of anatomy and physiology. No discovery has yet been made in any science more astonishing than the detection and production of minute animated beings *without parents*, out of nothing more than putrid vegetable infusions,—facts which never can be suppressed or explained away,—the most subtle disputants have been alike unable to digest or get rid of them.

None are apt to treat microscopists with more lively contempt than some supercilious astronomers and even mere star-gazers. Astronomy is certainly the most sublime of all the sciences—I have the most profound veneration for it. But star-gazing forms a distinct department, (though apt to be confounded with it,) and is, in my opinion, little better than gazing at anything else, or downright microscophizing. What is the usual fate of telescopes when not employed as regular astronomical tools? After they have exhibited the spots in the sun,

the moon through a few lunations, with an eclipse perhaps, the planets in succession with their occultations, and the eclipses of their satellites, the double stars, the milky way, and the nebulæ and clusters which are within their reach, together with such terrestrial objects as surround the dwellings of their possessors *, they are usually quietly interred in their cases, or craned up into a garret, there to enjoy their *otium cum dignitate*. Or it may be they will be mounted occasionally, just to show people what a prodigiously scientific personage their possessor must necessarily be. The fact is, that the objects which a telescope shows us as a mere optical instrument are numbered, and far more easily exhausted than microscopic ones. If to the telescope belongs the great and sublime spectacles of nature, to the microscope belong the *petites* and the beautiful ones; the former showing the world above us, the latter the world beneath us. Had my fortune, health, and capacity permitted me to become an astronomer, I should certainly never have descended to microscopical pursuits, but procured a large Herschelian telescope of some twenty inches aperture, and with it have swept and ransacked the *southern* hemisphere for nebulæ and clusters of stars, as the immortal Sir W. Herschel has done our northern one. But the fates have not permitted this; so as I have not been able to get a mackerel I have been forced to content myself with a sprat—(to use the homely but expressive adage.)

There is an argument which it seems to me may be used with force and effect, to justify or palliate an indulgence in microscopical researches: it is simply this. Nature has been pleased to bestow a most exquisite degree of finishing upon some of her works, such as can only be perceived and appreciated by man when assisted by the microscope. Now is it not monstrous and insupportable that men, *confessedly only the works of nature*, (and perhaps by her considered as little better

* Or if in town, perhaps, to exhibit the billings and cooings of the he and she gentry from the country, on the gallery which surrounds the dome of St. Paul's, or the Monument—(it is possible to find out low and degrading occupations even for the telescope.) I have heard of an American gentleman who was called out from a ball-room, for making use therein of an inverting opera-glass, *to turn the ladies topsy turvy.*

than insects devouring each other in a ball of clay,) should take upon themselves to ridicule and deride those who merely gaze upon and admire the minutiæ which she has chosen to execute in so inimitable and so exquisite a style? *Parva læves capiunt animos*, it is said; but I say it is not only unscientific but even swinish and ridiculous to contemn anything merely on account of its minuteness. Will any one pretend to advance, that if human beings had been made as perfect as they are upon a scale of an inch to a foot, they would have been less worthy of their divine author*? Or to put a case which will come better home to our clumsy feelings, clumsy senses, and clumsy fingers, suppose the automaton chess-player had been made on a scale of $\frac{1}{10}$ inch to a foot, would it have been less worthy of admiration, as a work of art?

Again, suppose some individual greatly distinguished for his talents in ship building, in the formation of steam-engines and astronomical instruments, and the like, was also to exhibit a passion for making musical seals and snuff-boxes, or even such curiosities as a dozen of silver spoons in a cherry stone, or a coach drawn by fleas, would it be good breeding or good taste to contemn and ridicule his minute labours, while we extolled his grander and more imposing works? Now it appears to me, that the Supreme Being does in some sense resemble such an individual; for there is nothing too grand or too *petite*, too sublime or too humble, too minute or too exquisite, to be above or below his consideration. His power loves to display itself *in every possible way in which it can be displayed;* and I cannot help thinking myself, that those who despise the minute works of God, while they affect to admire the great wonders of his creation, are guilty of a species of impiety, and must be either liars, or hypocrites, or fools. People are perpetually wondering at what can be the use of bugs and fleas, and wasps and such kind of vermin, and speak of them as if they were absolute

* Proportioning the cause to the effect, we might be led to the conclusion, that excessive minuteness has a certain power of fettering and confining the operations of nature. It seems certain, that the smaller animated beings become, the more simple is their structure: the termination, or if we please, the beginning of the scale in the Monas Termo and other animalcules of that class, are little more than mere animated vesicles or hydatyds on the small scale.

blots in the escutcheon of the Creator. The use of these little insects is, in my opinion, to teach man that most desirable, but most difficult of all lessons, true humility. He is very apt to consider himself as the very centre, the alpha, and omega of the creation, for whose use and satisfaction this planet and every thing in it has been made. Now a very little consideration ought to show him that this is by no means the case, and that he only shares with other animals (according to the degree of his force and cunning) the goods of the earth. Fleas, bugs, and wasps, seem to have been intended to enjoy themselves in their own way just as we do, without reference to the comforts, feelings, misery, or happiness of men and other beings, or as the lion and tiger can only exist by destroying weaker animals. Each animated creature seems almost to stand by itself, as much as if there had been no others to contend with it for the produce of the earth, both animal and vegetable.

I have frequently amused myself with imagining what would be the reflections of a bug, if it could think or reason. I have no doubt it would consider itself as the only being in the creation, of any real consequence, and be full of gratitude for the munificent provision made for it by nature in our bulky persons, which it would, doubtless, think had been created only to prepare its habitation and supply its food. The wars we wage against them, would be considered the most execrable cruelty and tyranny, and a most unaccountable contradiction in the order of nature, that the same being which supplied all their comforts, should also be their bane and destruction.

Upon the whole it seems quite as certain that bugs were intended to prey on man, as that horses were made to ride on. Pull in your horns a little, O ye lords of the creation! ye are but food for bugs while ye live, and for worms when ye are dead.

There are puerilities, pedantry, and nonsense in all the sciences. Even astronomy is not exempt from these flaws, nor is it by any means difficult to apply the touchstone of ridicule and derision to them, as has been done pretty successfully by Dr. Swift, and others: if mere utility is to be made the standard of excellence, how circumscribed are the merits of most of

them, barring their effect in acting as counterpoises to superstition and barbarism; and in this point of view, microscopic science has its voice among the rest. All men are apt to despise the pursuits of their neighbours and to dignify their own, whatever they may be, as the only ones of real importance and value. While microscopic investigations are consecrated by the names of Pond, of Amici, of Herschel*, and of Woollaston, who disdain not to relax themselves from their severer studies in such pursuits, a man must be very hardy and fastidious to dare to spurn or scoff at them.

I wish not to see microscopes or microscopic researches exalted any higher or debased any lower than their just level; but I have been frequently taunted with their insignificance and frivolity, and have, therefore, entered into the preceding vindication of them. I hope I may conclude by saying that we have a right to ride our hobbies quietly along the road, *without being considered any greater fools than our neighbours.*

I must confess that great disgrace has been brought on microscopic science, by the manner in which the earlier observers have perverted it to the support of preconceived opinions and hypothetical views, as well as to the spirit of wonder-making. I trust, however, that since microscopes have been placed on a par with telescopes, in point of the science necessary to their construction, that observations made with them will possess the same precision and scientific accuracy as those of astronomers, or at least that vain and lying details, *ad captandum vulgus*, will be exploded from the pages of microscopic lore in future.

* In No. 111, of the *Edinburgh Philosophical Journal*, Art. 20, may be seen a most beautiful model of scientific investigation with the microscope, by Mr. H. entitled, "On certain optical Phenomena exhibited by Mother-of-Pearl, depending on its internal Structure," and in Art. 32, of the same volume, an account of Professor Amici's discoveries relative to the motion of the sap in plants, (the chara or stone-wort.)

Hieroglyphical Fragments.

WHATEVER may be done by the liberality of the French government hereafter, in promoting the investigation of Egyptian Antiquities, the spirit of private individuals among our countrymen has, of late, been so active as to promise to exhaust all the accessible materials before our rivals commence their operations. Mr. BURTON's drawings of the Chamber of Kings, at Thebes, have already been lithographized; though his fellow labourer, Mr. WILKINSON, has been less fortunate in sending home his manuscript on the same subject, which has been lost on its way. Mr. WILKINSON is, however, still employed, with unremitting zeal, in increasing the bulk of his collections; and his drawings appear to be as accurately copied, as they are beautifully executed; and Major FELIX has even lithographized, at Cairo, some very interesting plates of names, arranged in chronological order.

Among some drawings lately received from Mr. Wilkinson by his friends in England there are two of particular interest. The one is a ceiling from the Memnonium at Thebes; the other a tablet from a tomb at Beni Hassan.

The first of these contain twelve months in order; they are distinguished by three different characters, accompanied by numerals from one to four, nearly in the same way as the months communicated by Mr. CHAMPOLLION to Dr. YOUNG for his Hieroglyphics. This mode of expressing the months appears to be sufficiently observable in the enchorial as well as in the sacred characters: and Mr. Champollion is evidently acquainted with their signification, though the characters cannot possibly have any relation to the sounds of the Egyptian words by which the months are denoted.

There is, however, an extraordinary difficulty in the reading of a passage in the Pillar of Rosetta, in which the name of the sixth month Mechir occurs, though it is denoted by the character which in this series answers to Paophi the second month. The first tetrad, beginning at the middle of the ceiling, is marked by the character of a garden or a corn field; and this character is also in the Thoth of the triple inscription, repeated, as denoting,

in all probability, the Thoth of each year: the second tetrad has an open square and an oval; and the third a long parallelogram, which occurs, as it ought to do, in the Mesore of the pillar. But Mechir has the garden instead of the open square and oval; yet it is perfectly well determined, and liable to no doubt or ambiguity whatever from the context: so that whether it was an error of the engraver, or a different dialect of the language, must remain for the present doubtful.

The tablet from the tomb at Beni Hassan is also singular for the *sublime* nature of the subject to which it relates, and as a genuine specimen of the high importance which ought to be attached to the interpretation of *all* the *mysteries* of Egypt. It is no less than a child's spelling book, in the Greek character however: had it happily been in the Egyptian character it would have been seriously invaluable. It begins with the alphabet from Α to Ω; then from Ω to Α; then Α, Ω, Β, Ψ, in direct and inverse order alternately, that the child's memory might not assist his perception too much: then we have ΒΑ, ΒΕ, ΒΗ, ΒΙ, ΒΟ, ΒΥ, ΒΩ; ΓΑ, and so forth to ΨΩ; then ΒΑΒ, ΒΕΒ, ΒΗΒ, and the rest of the syllables similarly formed, as far as ΔΩΔ; with which the child's first lesson appears to have ended. This at least we may probably infer, that the tenant of the tomb was probably a schoolmaster or schoolmistress: at any rate that he had learned to read and write, and that his survivors were proud of his qualifications.

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Park Square, March 14.

On the Climate of the Canary Islands.

THE following remarks on the climate of the Canary Islands are an epitome of the portion, allotted to that subject, in the very valuable treatise of M. von Buch, entitled, "Physicalische Beschreibung der Canarischen Inseln."

1. *Temperature of the Atmosphere.*—It was highly to be desired that a correct mean temperature, at the level of the sea, should be obtained in some latitude, which might connect the valuable and exact determinations made by Humboldt within the tropics, with the many careful registers which are

kept north of the forty-fifth parallel. The observations of Heberden, at Madeira, in 1750, which were the only ones existing in the intermediate parallels alluded to, could not be regarded as sufficiently satisfactory for this purpose. The desideratum has been at length supplied by a most careful register kept at Santa Cruz, in Teneriffe, with good English instruments, in an open gallery in the shade, from May 1808, to August 1810, by Don Francisco Escolar. The temperature of each day is derived from the mean of two observations, one made at sunrise, and the other at noon, or a little later. It might appear, at first view, that, whilst the observation at sunrise may, without hesitation, be admitted to have shown the minimum,—that at noon, or a little later, might not justly represent the maximum,—and, consequently, that the mean derived from them would give a temperature somewhat too low; and this view might receive confirmation, on observing that the average temperature of the noon register does not exceed that of sunrise by more than 1°.16 R. or 2°.6 Fahr. But experience has shown that, in the islands of warm climates, the maximum of heat very rarely, indeed, happens so late in the day as halfpast one: that it more frequently occurs a little after eleven, but most frequently about noon. The increase of heat which takes place elsewhere after the sun has reached the meridian, is, in such localities, counteracted by the sea breeze, which, springing up when the sun has reached a considerable altitude, increases in strength, in proportion to the effect produced by the sun's increasing heat upon the land. And in respect to any inference which might be drawn from there being so small difference between sunrise and noon in Escolar's register, the observations of Heberden, which contain the highest and lowest temperatures experienced in every month in Madeira, show that, in no single instance, the range of the thermometer for the space of a whole month exceeds in that island 2°.91 R., or 6°.5 Fahr.

From these considerations M. von Buch concludes that Don Francisco Escolar's observations may be regarded as affording a fair representation of the mean temperature at Santa Cruz. The abstract of the register gives the following mean temperatures for each month in the year:—

	Reaumur.	Fahrenheit.
January	14.15	63.7
February	14.35	64.3
March	15.63	67.1
April	15.70	67.2
May	17.83	72.1
June	18.62	73.8
July	20.12	77.2
August	20.84	78.9
September	20.19	77.4
October	18.96	74.5
November	17.08	70.4
December	15.03	65.9
Mean of the whole year	17.31	71.0

The progression of the temperature in the different months follows the law common to places without the tropics; the greatest heat and the greatest cold are in the months following the solstices. The mean temperature of the coldest month, January, is the same as the mean temperature of the whole year in southern Italy.

Rains.—By the character of the rains, the climate of the Canary Islands is also assimilated to the temperate zone, rather than to the zone of the tropics; there are no tropical rains, and the rains which take place occur at that season when the temperature differs most from that of the equator. Their cause is the same as elsewhere beyond the tropics; the cooling of the upper current of the atmosphere, in its passage from the equator, and the deposit of the great quantity of vapour with which it is charged. In consequence of the greater warmth of the climate of the Canary Islands, this deposit does not take place there so soon in the autumn, or continue so late in the spring, as in Italy, or in countries still further to the north. It scarcely ever rains on the sea coast earlier than November, or later than the end of March.

Winds.—During the summer months, the climate of the Canaries is assimilated by the winds to the region of the tropics. From April to October, the N.E. trade-wind prevails uninterruptedly. During the remaining months it partakes of the

character of the zone without the tropics, by the general prevalence of south-westerly winds.

These islands are just within that distance from the continent of Africa, which enables them to present highly interesting examples of the gradation in which the true direction of the trade-wind (that is to say, the direction in which it ought to blow, from the general causes which occasion it) is deflected from the influence, and in proportion to the vicinity of a great continent. Within sight of the coast of Africa the wind is found N. by E.; at Lancerote and Fuertaventura, N.N.E.; at Canary, N.E.; at Teneriffe, N. E. by E.; and the influence of the continent ceases to be perceptible at Palma. At all seasons of the year, even when the N.E. Trade is strongest in the lower regions of the atmosphere, the S.W. current, or the general flow of the atmosphere in the upper regions from the equator towards the pole, is experienced by ascending the high land of Teneriffe, and of other islands in the group. Evidence is thus afforded of the steady prevalence of that upper current, the cause of which has been so satisfactorily explained by Mr. Daniell, and of which the existence had been also manifested by the phenomena of the fall to windward of the ashes of the volcano of St. Vincent's, quoted by M. von Buch, from Mr. Daniell's Essays. In proportion as the sun advances to the southward of the line in autumn, the limit of the trade-wind towards the north progressively recedes, following the sun. Thus, the N.E. trade, which, in the height of summer, reaches even the coast of Portugal, fails there, while it yet prevails at Madeira; and, in like manner, fails at Madeira, while it still blows at the Canaries. Several very remarkable phenomena observed at the Canary Islands, appear to justify Mr. Von Buch's opinion that the N. E. trade-wind does not flow parallel to the surface of the earth, but that it has a gradual ascent in its progress southwards. It seems difficult otherwise to explain the great extent of lee occasioned by the several islands, which has been carefully and accurately examined at each. At Canary the lee is from twenty to twenty-five sea miles; at Teneriffe, fifteen; at Gomera, ten; and at Palma, thirty sea miles. The distance to which the lee extends is well defined by the breaking of the sea upon the smooth water, with so

much violence as to be even dangerous to vessels. On the supposition that the course of the trade-wind is an ascending one, it might be expected in autumn to cease to blow at heights some days before it ceased on the sea shore, progressively descending in height as the northern limit of the wind at the surface of the sea approached the island; and such is found to be the fact. The S.W. wind, which takes the place of the trade-wind as the latter ceases to blow, is observed in all years to descend progressively from those highest points, on which, as has been remarked, it prevails throughout the year. Its descent is traced by the clouds, which, in October, veil the south side of the Peak of Teneriffe; sinking slowly, they rest on a ridge of mountains, between Orotava and the southern coast, six thousand feet in height, where they break in dreadful storms. It is a full week, and sometimes even more, before the S.W. wind is felt on the sea coast, where it prevails for months afterwards, whilst it rains on the declivity of the mountain, and snow is on the Peak. A remarkable fact, viewed in this connexion, is the greater height of the barometer in the summer months, when the opposite currents are prevailing over the island, than in the winter months, when the S.W. alone prevails. The mean of Don Francisco Escolar's register, kept during three years, gives, for the months of winter and summer respectively, as follows, the heights of the column of mercury being reduced for temperature.

	Inches.	Lines.
May, June, July, August . .	28 „	3.173
September to April . . .	28 „	2.017
Excess of summer over winter .		1.156

or rather more than one-tenth of a British inch.

The island of Grand Canary presents a remarkable peculiarity in the progression of its mean monthly temperature, which is highly worthy the attention of meteorologists. The following table exhibits the result of a register kept at Las Palmas, during ten years, by Dr. Bandini de Gatti. The time of observation was daily at noon; from whence the results inserted in the first column are immediately derived: those in the second column are the approximate *mean* temperatures, derived from the observations at noon, by presuming the same

difference to exist, which has been already stated to have been observed at Santa Cruz between the temperature of noon, and that of the mean between noon and sunrise.

Months.	Monthly Mean derived from the Noon Observations.		Approximate Mean Temp. each Month computed.	
	Reau.	Fahr.	Reau.	Fa
January . .	14.05	63.5	13.30	62
February .	14.52	64.6	14.06	63.5
March . .	15.10	66.	14.56	64.7
April . .	15.79	67.4	15.25	[illegible]03
May . . .	16.68	69.6	16.10	68.2
June . .	17.53	71.5	17.[illegible]	70 2
July . . .	19.24	75.3	18.50	73.6
August . .	20.41	78.1	19.[illegible]5	76.1
September .	22.26	82.1	21 61	80.7
October . .	23.74	85.3	[illegible]6	84.1
November .	18.67	73.9	[illegible].76	[illegible]2.9
December .	14.51	64.6	13.[illegible]	63.3

By this table it is seen that the maximum of heat takes place at Las Palmas in October instead of August; that as far as September the progression is regular, and accords with the register of Santa Cruz; but that, instead of diminishing in September and October, as is usual from the decreasing southern declination of the sun, the heat, on the contrary, continues to augment, until in the middle of October it attains a height only known in the hottest tropical climates. The general understanding of the inhabitants corresponds with the register; and the peculiarity of the climate is marked, as might be expected, by a corresponding peculiarity in the vegetation. Thus the Palm-trees, from which Las Palmas takes its name, and which flourish greatly in its vicinity, yield ripe dates in abundance; whereas the . . trees of the same kind which are found in Teneriffe do not ripen fruit. The Euphorbia Balsamifera, which requires a great deal of warmth, is found in the neighbourhood of Las Palmas, as high as eight hundred feet, forming bushes ten or twelve feet high; whereas at Santa Cruz, and at Oratava, it hardly rises above the ground. Nearly the same may be said of the Plocama Pendula. The gardens of Canary are adorned with East and West India trees, not seen in Teneriffe; Poinciana Pulcherrima, of uncommon size and beauty; Bixa Orellana and Tamarind trees, as large as the Lime-trees of Europe. A magnificent avenue of the large trees of the Carica Papaya, or Papaw tree, is found in the hospital of

St. Lazarus; all these testify that, during a part of the year at least, Canary is subject to a degree of heat peculiarly intense.

Mr. von Buch attributes this remarkable peculiarity in the climate of Grand Canary to the cessation of the trade-wind in September, when a period of calms intervenes before the south-west wind is steadily established; during these calms, the atmosphere near the island, being undisturbed by the local winds which prevail at the same period at the other islands, becomes greatly heated by the effects of solar radiation, to which the peculiar form and geological character of the island conduce in a more than ordinary degree. It is, we believe, the first phenomenon of the kind that has been noticed, and is highly curious as a meteorological fact, as well as in regard to the influence of climate on vegetation.

Temperature of Springs and Fountains in Teneriffe.—It has been already observed, that the rains take place only in the winter months, from November to March; but during the summer months there is a constant precipitation from nine or ten in the morning to five in the evening, in the region of forests, at the elevation of from 2500 to 4100 feet. From whichever of these sources we suppose the springs or fountains to be supplied, it is reasonable to expect that the temperature of those that are found near the level of the sea should be colder than the mean temperature of the year at that level. Accordingly, it appears that the average temperature of the following springs, ascertained by M. von Buch, is 14.25 R., or 64.1 Fahr., whilst the mean temperature of the year, as shown by Escolar's observations, is 17.3 R., or 71. Fahr.; or, on the average, the temperature of the springs near the level of the sea is 7° Fahr. colder than the mean temperature of the air during the year.

6th May.—An uncommonly fine and copious spring, gushing out from under a bed of lava, at Cape Martianez, under La Paz, near Oratava - -	14.2 R.
This temperature is permanent throughout the year.	
8th May.—The spring "del Rey," between Realexo and Puerto - - - - - - -	14.3
7th June.—The same spring - - - - - -	14.8

6th Sept.—The same spring - - .. -	14.8 R.
1st June.—Very copious springs, gushing out like waterfalls from the rocks beneath the mill of Gordaxuelo, near Realexo - - - -	13.3
6th Sept.—The same spring - - - -	14.1

Up to the height of 2000 feet above the sea the temperature of the springs, generally, suffers scarcely any sensible diminution; consequently the mean temperature of the air in ascending gradually approaches that of the springs. Above 2000 feet, and between that height and the commencement of the forest region, the springs diminish considerably and rapidly in temperature all round the island, as is shown by the following examples:—

August.—Agua de las Mercedes, 2200 feet, in the wood of Obispo above Laguna, under gigantic laurels - - - - - - -	11.2 R.
Sept.—Fuente de Vero, and Fuente de los Villanos, 2800 feet - - - - -	10.6
June.—A spring near the hermitage of Esperanza, 2100 feet - - - - -	12.2
August.—Fuente Guillen, a spring between Esperanza and Matanha, 2565 feet - - -	12.1
May.—A copious fountain in the rocks above Realexo ariba, 2600 feet - - - -	11.9
May and June.—A spring on the mountain of Tigayga, 2000 feet - - - -	11.9
May and June—A spring on the left side of the Baranco, leading to Rambla, 2000 feet -	11.7

At the commencement of the forest region, therefore, the average temperature of the springs may be considered as 11° R. or 3° less than at the level of the sea. From that height to the upper limit of the forest region, where the precipitation furnishes a constant supply, the water in deposits differs little from the temperature of the air: and above that region, the springs are too few, and too inconsiderable, to preserve an independent temperature.

E. S.

On a Figured Variety of Coal, occurring in the Coal-field of Glamorganshire; in a Letter to the Editor.—By J. Mac Culloch, M.D. F.R.S.

Dear Sir,

I was not aware that the singular variety of coal, to which the title of this letter alludes, was unknown to mineralogists, or I should not so long have delayed sending you this notice of a peculiarity, which, independently of the difficulty which it presents, offers a fact deserving of regard in the history of this interesting substance. I must presume, that it has never yet occurred elsewhere, than in the place whence the specimens, which I have seen, were procured; because a form so remarkable could not have failed to attract the attention even of the workmen, and would, therefore, have, ere now, been brought before the attention of mineralogists. Should it merely have been overlooked in other coal deposits, the present public notice may serve to call attention to it; and, perhaps, also induce mineralogists, as well as workmen, to examine more narrowly into a substance, which, in spite of its importance and familiarity, must have been strangely neglected, when such doctrines respecting its chemical nature, as those of Mr. Kirwan, and respecting its chemical origin, such as those of Sir James Hall, and Playfair, could have been received, without question, for so long a time, and entertained as truth till they were corrected, at so very late a period, by my own examination of bituminous substances, appended to the Essay on the Distillation of Wood, in the *Geological Transactions.*

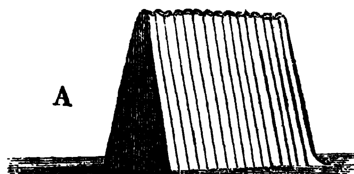
The variety, to which I allude, has been frequently found in the coal works about Merthyr Tidfil, and, indeed, may be said to occur almost daily; but how widely it may extend through this coal basin, there are no means of knowing. It would be superfluous to describe, either the nature of this coal-field, or of the coal itself, since both are familiarly known; it may be sufficient to remind your readers, that it is a dry coal, though not, in this respect, of a very highly defined character; while I hope that they are already aware, from the paper to which I have alluded, that there are no definite varieties of coal, as is commonly supposed, in consequence of certain misleading and

popular designations; but that a regular gradation exists between all the varieties, from the driest Kilkenny coal or culm, to the most bituminous coal of Newcastle; or, chemically speaking, from anthracite to asphaltum.

The term commonly applied to this variety, by the miners, is crystallized coal: that it is not a true crystallization, will be apparent, though it will be difficult to refer it, as will presently be seen, to any other class of forms or causes than that undefinable one, termed concretionary, and to the peculiar laws, whatever those are, by which these forms, so often connected with, or approaching to, perfect crystallizations, are regulated.

It would have been desirable to give a finished and accurate engraving of a form, which words alone will scarcely render intelligible; but as obvious causes render this impossible in your Journal, your readers must be contented with an outline, which, with that idea of the distribution of the general structure on the surface, that can be conveyed in words, and the addition of a few sentences, may perhaps render the subject sufficiently clear for the present purpose.

The surface of this variety of coal displays that involution of lines, which is commonly known by the term snail-creep; and that character is accurately preserved in every specimen which I have seen. These specimens, therefore, bear a general resemblance to that well known madreporite, vulgarly called brainstone: inasmuch that the first impression is, that this coal has been in some manner connected with some organic body of this nature. A moment's consideration, however, shows that this could not have been the case; and even a cursory examination proves that, whatever the resemblance may be, the differences are still greater. This apparent disposition is part of a structure which perhaps the appended wood-cuts, though rather diagrams than representations, may render intelligible.

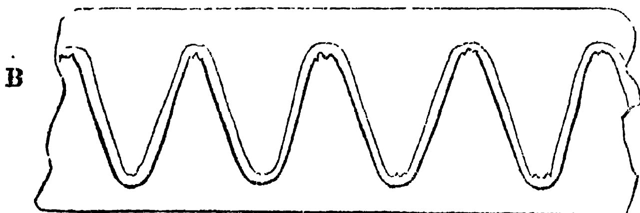


The outline in question is the protruding edge of a ridge

arising from the general flat surface of the block of coal, and so convoluted as to produce this figure on the plane. A section of that ridge, across any part of its course, gives a wedge-like form, as is shown at A; the base being continuous with the ordinary coal, and the edge, which has a sensible breadth, varying from the twentieth to the eighth of an inch, being serrated. The face or plane of this convoluted wedge (if I may use such a term) is striated, or apparently fibrous; but, when broken, no appearance of fibres is visible, the whole being undistinguishable in aspect and character from the general block; which is in no way different from the ordinary coal of the same strata. Lastly, in all the specimens which I have seen, the length of the wedge, or the height of the ridge, is about an inch, perhaps rather falling short than exceeding. With respect to the convolutions, I must yet remark, that, while they are perfectly capricious and uncertain, so as to differ in every specimen, they conform most rigidly to a sort of law pervading the convoluted madrepores, which may be called the law of avoidance, and for which, in those corals, there is an obvious cause, arising from the design of the animals by which it is constructed. The same law, and for similar reasons, is found in the honeycomb; but it will probably long remain a mystery why it should occur here, where no apparent cause can be assigned. What I here allude to is, that, however the curve may wander and be contorted, the neighbouring one always follows at an exact distance, as far as any single point is concerned; though as this second, or any other curve, may hold a very different general course, spaces must occur which would be greater than the general interval, which, for a reason that will presently appear, is equal to the base of the wedge, or ridge, or somewhat more than a quarter of an inch. Such intervals will be found occupied by straight pieces, or other adaptations, in such a manner as always to preserve this mixture of average distance and avoidance: just as is familiar in the honeycomb, when the form of the hive does not allow the whole to be filled in a more regular and continuous manner; a proof, by the way, that bees do not follow a fixed rule, or are not solely guided by what has been idly and obstinately called instinct.

I must now point out the only remaining singularity of this

coal; and it is one probably which has often prevented it from being remarked, as it doubtless causes the specimens to appear more rare than they actually are. The eye does not conjecture where they are to be found; or the blocks, which contain this structure, are not different in aspect from the ordinary portions of the stratum. It is only from casual fracture that they come to light; while many are destroyed every day in the act of breaking up the materials for the coal hearths. If the fracture has been fortunate, the block divides in the middle, parallel to its stratified structure; and, on separation, each piece is found to contain the projecting figure which I have described; the ridge on the one-half fitting exactly to the vacuity in the other, and admitting them to be refitted just as the fingers of two hands may be so adapted.* Occasionally, some adhesion occurs between the opposite portions; in which case a portion of the ridge on one block is broken off; but I have seen specimens of nearly a square foot in surface, where the whole was absolutely perfect. This circumstance is the one to which I referred above, as explaining the reason why the intervals between the ridges or curves, at the surface, were equal to the breadth of the ridge at the base. The cut B represents a kind of section of this fact.



Such is the description of this singular variety of coal. I do not pretend to explain it. There would be no difficulty in filling a page with conjectures and hypotheses in the usual taste; but while there is no analogy to which it can be referred, nor any general law elsewhere, with which it can be associated, I can see no purpose in such waste of words. It is not possible to conceive how it can have depended on any animal structure, for various reasons; nor are there any means of referring it to

what, were it really organic, it ought rather to belong—some vegetable form. The adaptation of the opposed parts would, itself, exclude those; and thus, therefore, must the question at present remain, until we become more extensively acquainted with the concretionary structure, and the laws, by which that is regulated; a subject on which I formerly attempted to throw some light in your Journal.

I am, &c.

Remarks on the Ruins at Palenque, in Guatemala, and on the Origin of the American Indians. By John Ranking, Esq.

THESE ruins are situated on a plain, named Palenque, in the province of Ciudad Real de Chiapa, near the borders of Guatemala and Yucatan, in north latitude, by Robertson's map, 17° 30'.

A description of this ancient city has been published in English*, translated from the manuscript of Captain Don Antonio del Rio, dated Palenque, 1787, accompanied with a critical investigation into the history of the ancient Americans, by Doctor Paul Felix Cabrera, of the city of New Guatemala, dated 1794. The following is a summary:

The king of Spain having ordered another examination of these ruins, Captain Del Rio proceeded to the site of the ancient city, which is called Casas de Piedras (stone houses) for the purpose of effectually clearing away the trees and copsewood which hid the principal building. With seventy-nine Indians and forty axes the wood was cut down in fifteen days, and was consumed in a general conflagration, which enabled the party to continue their operations with more facility. The pick-axes were reduced to three, and the iron crow-bars to seven; but, by dint of perseverance, all that was necessary to be done was effected, and, ultimately, there remained neither a window nor a doorway blocked up, nor a room, corridor, court, tower,

* By H. Berthoud, Regents-Quadrant, and Suttaby & Co., Stationers-court, 4to, 1822, with seventeen plates. "The original manuscript of Captain del Rio, with the criticism of Dr. Cabrera, was found in the archives of New Guatemala, and is open for inspection at Mr. Berthoud's."—*Prefatory Address.*

nor subterranean passage, in which excavations were not effected two or three yards in depth.

There are fourteen stone houses situated upon a height, some more dilapidated than others, but many of their apartments being perfectly discernible. At the base of the highest mountain forming the ridge, there is a plain four hundred and fifty yards long and three hundred wide. In the centre, upon a mound twenty yards high, stands the largest structure that has yet been discovered, under which is a stone aqueduct of great solidity. It is surrounded by five other edifices on the north, four on the south, three on the east, and one on the south-west. In all directions fragments of other fallen buildings of the town are to be seen, extending along the mountain, that stretches east and west about three or four leagues either way. Its breadth is little more than half a league at the point where the ruins terminate. The interior of the large building is in a rude and massive style of architecture, resembling the Gothic; the entrance, on the east, is by a portico, or corridor, three yards in width and thirty-six in length, supported by plain rectangular pillars, without bases or pedestals, upon which are square smooth stones, more than a foot thick, forming an architrave; while on the exterior superficies are stucco shields, the designs of three of which accompany this report, numbered 1, 2, 3*. Over these stones there is a plain rectangular block, five feet long and six broad, extending over two of the pillars. Medallions, or compartments in stucco, containing different devices of the same material, appear as decorations to the chambers; and from the vestiges of the heads which can still be traced, it is presumable that they were the busts of the kings or lords to whom the natives were subject. Between the medallions there is a range of windows the whole length of the wall, like niches; some are square, some in form of a Greek cross, and others, which complete the cross, are square, being about two feet high, and eight inches deep.

Beyond this corridor there is a square court, entered by a flight of seven steps. The north side is in ruins, but we may

* These, and many other things described, are not represented upon the seventeen plates published, no more having been found with the manuscript; and those seventeen which accompany the quarto, have no numbers, or marks, whatever for reference, but are given just as they were received by the publisher.

see that it had a similar chamber and corridor with those on the east. The south side has only four small chambers, with nothing but two little windows, like those described above.

The western side corresponds to its opposite in all respects, except the variety of expression of the figures in stucco; these are much more rude and ridiculous than the others, and can only be attributed to the most uncultivated Indian capacity. The device is a mask with a crown and long beard, like that of a goat; under this are two Greek crosses, the one delineated in the other, as appears in Fig. 7*. Proceeding in the same direction, there is another court, somewhat similar to the last. Some pillars yet remain, on which are relievos, alluding to the sacrifice of some wretched Indian. I have transported from this chamber the stucco head of the sufferer, (Fig. 8.) and the foot and leg of the sacrificer, (Fig. 11.) There is a tower on the south side, (Fig. 12.); its height is sixteen yards, and to the four existing stories there has, perhaps, been a fifth with a cupola. These piles diminish in size, and are without ornament, yet the design is singular and ingenious. There is an interior tower, quite plain, with windows to give light to the steps by which you ascend to the summit. A solid body passes through the centre of the tower, from which the earth and stones slipped down, and prevented us from excavating more than three yards.

Behind the above four chambers, there are two others, larger, and well ornamented in the rude Indian style, and appear to have been oratories. Among the embellishments are some enamelled stuccos, (Figs. 13 and 14 ;) the Grecian heads represent sacred objects, to which they made their offerings, probably consisting of strings of jewels, as the attitudes denote†. Beyond these oratories there are two apartments, each 27 yards long and three broad, containing nothing but an elliptical stone embedded in the wall, about a yard above the pavement, the height of it is one yard and a quarter, the breadth a yard. At the extremity of an apartment, on a level with the pavement, there is an aperture like a hatchway, two yards long, and more than one broad, leading to a subterranean passage, by a flight of steps,

* *Figure* is used throughout the Spanish account for *Plate*.

† Montezuma and Cortez put necklaces on each other; it is a Mongul, or Mogul, custom, for these two spellings are used by all writers indifferently.

which has, at a regular distance, flats or landings, each having its respective doorway, ornamented in front like Fig. 18. Fig. 19 represents another entrance, and there is a third buried beneath heaps of rubbish. In another of the many entrances, there was a stone, (No. 7,) which I broke off from the left hand side of the first step, with various devices in bas-relief, as in Fig. 20. On reaching the second door, we continued the descent, with artificial light, by a very gentle declivity. Turning at right angles, we entered through a door into a chamber sixty-four yards long, and nearly as large as those before described; beyond this there is another, exactly similar, having light from windows commanding a corridor fronting the south. Nothing was found in these places, except some plain stones, two yards and a half long by one yard and a quarter broad, supported by four square stands of masonry, rising about half a yard above the ground, partitioned off in the forms of alcoves, and were obviously receptacles for sleeping.

On an eminence to the south, there is a building about forty yards in height, forming a parallelogram, resembling the former in architecture; it has square pillars, an exterior gallery, and a saloon, twenty yards by three and a half, embellished with a frontispiece, on which are described female figures, with children in their arms, all of the natural size, in stucco medio-relief; they are without heads, as in Figs. 21 and 22. Some whimsical designs, as ornaments to the corners of the house, were brought away; they are numbered 8, 9, and 10. The inhabitants used such devices for the conveyance of their thoughts, but we cannot know their real meaning. In the gallery there are three stones, each three yards high and one broad, covered with the hieroglyphics in bas-relief recently mentioned. The whole of the gallery and saloon are paved. Passing by some ruins, in a little valley there is a similar structure. (Fig. 23.) Eastward there are three small eminences, forming a triangle, upon each of which is a square building, eighteen yards long, and eleven broad, having, along the thin roofings, superstructures about three yards high, resembling turrets, covered with ornaments and devices in stucco. In the interior of the first mansion, at the end of a dilapidated gallery, is a saloon, with a small chamber

at each end, and in the centre an oratory, three yards square, presenting, on each side of the entrance, a perpendicular stone, whereon there is the image of a man in bas-relief, as in Figs. 24, 25. On entering, the entire front is occupied by three stones, joined together, upon which there are the allegorical objects represented by Fig. 26. The outward decoration is a moulding, finished with small stucco bricks, and the bas-reliefs, Nos. 11 and 12. The pavement is smooth, and eight inches thick. In the centre, at the depth of about half a yard, was found a round earthen vessel, about a foot in diameter, fitted, horizontally, with lime to another of the same size. A quarter of a yard deeper, a circular stone was found, about a foot in diameter, and, on removing it, there was a cylindrical cavity, a foot wide, and a third of a foot deep, containing a flint lance, two small conical pyramids, with the figure of a heart in dark crystallized stone, named challa, and common in these parts*. There were also two small earthen jars, or ewers, with covers, containing small stones, and a ball of vermilion. There was another similar cavity in each of the corners at the entrance of the oratory, containing the little jars Nos. 17 and 18. These things convey to the mind, that this was the spot where they venerated the memory of their greatest heroes, for the characters and bas-reliefs surrounding them evidently prove it.

The other two edifices vary only in the allegorical subjects of the bas-reliefs on the stones. In the second were found the delineations of men, as in Figs. 27, 28, and the front exhibited the three stones displayed in Fig. 29. On excavating, there were discovered a flint lance, two conical pyramids, the representation of a heart, and two earthen jars, numbered 19, 20, 21, 22.

Figure 30, the last of this collection, shows the interior front of the third oratory; it is like the others. If due attention be given to the bas-reliefs thereon, the conclusion is, that the ancient inhabitants lived in extreme darkness†. In other similar edifices, completely in ruins; on digging there were found an earthen vase, broken to pieces, which contained some small pieces of challa, in the shape of lancets, or thin

* The Inca Huayna Capac, who died in 1527, desired that his body should be sent to Cuzco, and his *heart* to his beloved city of Quito.—Vega, ii. 414.

† See remark on Plate xii.

blades of razors, probably used as such by these uncivilized people*. They are numbered 23, 24. No. 25 is an earthen pot, containing a number of small bones, grinders, and teeth, found in the same excavation.

No. 26, and those that follow, denote the quality of the lime, mortar, and burnt bricks, used by the inhabitants. It may be inferred that the latter were used very sparingly, as all that could be found were brought away. On this second examination of this ruined city, no exertions have been spared to illustrate the points contained in the last royal mandate.

"Father de Soza describes other ruins between the curacy of Mona y Ticul and the town of Nocacab, twenty leagues from the city of Merida, (in Yucatan). One is a large building in good preservation, upon an eminence twenty yards high, and 200 yards on each façade. The natives name it Oxmutal.

"The apartments, the exterior corridor, the pillars with figures in medio relievo, of serpents, lizards, &c., formed in stucco; beside which are statues of men with palms in their hands, in the act of beating drums and dancing;—all resemble, in every respect, those in the buildings at Palenque.

"At a town called Mani, there is a conical stone pillory, (pillar?) and on the south a very ancient palace resembling that at Palenque. These and other buildings on the road from Merida to Bacalar, evidently *prove the identity of the ancient inhabitants of Yucatan and Palenque.*"—Page 6.

Regarding the *origin* of the inhabitants of Palenque, Captain Don Antonio del Rio says—"The conclusion must be, that the ancient inhabitants of these structures lived in extreme darkness; for in their fabulous superstitions we seem to view the idolatry of the Phœnicians, the Greeks, the Romans, and other primitive nations most strongly portrayed. On this account it may reasonably be conjectured, that some one of these nations pursued their conquests even to this country, where it is probable they only remained long enough to enable the Indian tribes to imitate their ideas, and adopt, in a rude and awkward manner, such arts as their invaders thought fit to inculcate."—Page 19.

* These are such as the Mexicans made their swords with.—See Clavigero, Plate xii.

"Father Jacito Garrido, a Dominican friar, who was in these parts in 1638, where he taught theology, and was well versed in the Hebrew, Greek, and Latin languages; cosmography, arithmetic, and music; has left a Latin manuscript, in which he states his opinion, that the northern parts of America had been discovered by the Greeks, English, and other nations, a supposition he deduces from the variety of languages, and some monuments in the village of Ocojingo, twenty-four leagues from Palenque; but these are the mere conjectures of the reverend writer, nor does he define the period when these alleged strangers arrived."—Page 12.

The result of Dr. Cabrera's disquisition regarding the peopling of America, which he says is an "historical obscurity that has hitherto fatigued the greatest talents in the world" (page 35) is this—"That Atlas made the first voyage to America; that Votan, a Hivite, third in descent from Hercules Tyrius, led a colony from Syria to Hispaniola, which is the island Atlantis; and from the capital of that island he embarked his first colony for the continent of America, and founded Palenque, from which city he visited the old world four times; that his port of arrival was Tripoli, in Syria; that he was in Spain, and that he visited Rome, and witnessed the building of the 'House of God,' by which is meant the temple that, during the consulate of Publius Cornelius Rufinus, was erected in honour of Romulus and Remus, B.C. 291; that it was from Votan that the Romans and Carthaginians obtained their first knowledge of America; and that Carthaginians emigrated, and founded the kingdom of Amaquemacan, (the original region from whence the Toltecs, Mexicans, and other tribes, arrived in Anahuac, and which Clavigero places in the north of America;) but that so many inhabitants emigrated, that the Carthaginian Senate passed a decree, commanding their return, as mentioned by Diodorus, and confirmed by Montezuma, in his discourses with Cortez; that the Carthaginians, fearing some disaster from the Roman arms, kept from those conquerors the secret of their having this secure refuge; that, according to Indian tradition, Votan wrote his own history, which was taken from a cave by an Indian lady, who gave up the historical tract, and that it was publicly burnt in the square at

Huguetan, in the year 1691; that it is, however, possible, that Votan's tract, or another similar to it, may be that which is in the possession of Don Ramon de Ordonez y Aguiar, of Ciudad Real, a man of extraordinary genius, and at this time occupied in composing a work, the title of which is, *Historia del Cielo y de la Terra*, which traces the original population of America from Chaldea, immediately after the confusion of tongues. His study of the subject for more than thirty years, and his skill in the Tzendal language, in which the tract is written, lead us to anticipate a work so perfect in its kind as will completely astonish the world."

The erudite Doctor concludes his critical inquiry, of 103 pages, "*about it, Goddess, and about it,*" in these words—"It was my intention to call this a new *Attempt* to solve the grand problem; but in consequence of the valuable information which I have acquired from the learned work of the Bishop of Sonoro, I denominate it a *Solution*, and in so doing I sincerely trust the reader will not ascribe such alteration to an overstrained confidence in my own abilities."

On the above opinions of the three Spanish authors, no other remark is required, than that they have entirely neglected to examine that part of Asiatic history, which is the true source from which the *solution* can be drawn, and which is offered as follows:—

Neither history nor tradition, worthy of regard, existed in any part of America, when discovered by Columbus, earlier than the sixth century of the Christian era; from which period the nations in Anahuac, beginning with the Toltecs, date their arrival. South of the line no annals whatever exist previous to the mysterious appearance of Mango Capac.—(A.D. 1283.)

The Toltecs are the first people known to have arrived in America. They left their own country, A.D. 544, supposed to be the eastern part of Asia, and tarried at Casa Grande, which they built, (N. lat. 34°, near California, by Robertson, 29° by Clavigero,) and other places, 104 years*; they then arrived in Anahuac; and in the year 670 they founded *Tula*, after

* Dr. Cabrera, p. 65, says the 104 years were passed in *Africa*.

the name of their *native* residence. They were acquainted with the art of casting gold and silver, and of cutting all kinds of gems. They brought with them from their *own country* an exact knowledge of the length of the solar year, where it had been known about a century before the Christian era *.

The Toltecs multiplied exceedingly, and extended their population in numerous and large cities; till, in the year 1052, they were dreadfully afflicted with drought, famine, and mortality, and their monarchy terminated. Some of the wretched remains removed to *Yucatan*, some to *Guatemala* †, and some dispersed themselves in Anahuac. There cannot be a doubt but that they had a clear notion of the Deluge. (*Clavigero*, i. 87.)

For about a century Anahuac remained nearly depopulated; when in the year 1170, a numerous party of Chechemecas arrived. They came from the north, and their native land they called Amaquemacan, where different monarchs had ruled their country many years. They were eighteen months upon the journey, and passed the ruins of the buildings of the Toltecs, (Casa Grande.) They had distinctions between the nobility and commonalty. They lived on game, fruits, and roots of spontaneous growth; were clothed in the skins of beasts, armed with bows and arrows, and worshipped the sun. They established themselves six miles north of the future Mexico. In process of time they formed alliances with the few Toltecs who had remained. Eight years afterwards, (in 1178,) six respectable persons, with a considerable retinue, arrived from a kingdom near Amaquemacan; these were the Nahuatlacs, and consisted of seven tribes, Sochimilcs, Chaleks, Tapanecs, Acolhauns, Tlahuics, Tlascaltecs, and Aztecs, who all spoke the Toltec language.—(See *Clavigero*, B. ii., *Humboldt*, *Res.* ii. 251.)

After the beginning of the thirteenth century, Acolhuatzin, and two other princes, arrived with a great army of Acol-

* See Clavigero, ii. 226. Humboldt, Researches, ii. 249. Conquest of Peru and Mexico by the Moguls, A.D. 1283, p. 268. The knowledge of the Toltecs, regarding the year of 365 days and near six hours, agrees *precisely* with the Chinese history. See Du Halde, folio ii. 230, and Conquest by Mongols, p. 274.

† There is not any thing in the history, as far as is known, to warrant the idea of greater antiquity of the ruins in question, at these two places.

huans: they were of the noble house of Citin. They represented themselves as sons of a great lord, and that they had been attracted by the reports they had heard of the hospitality of the Chichemecan monarch. The king was pleased with their manners, and gave his two daughters in marriage to the two eldest princes.

The last that arrived were the Aztecs. *The whole of the above spoke the Toltec language.* The Aztecs resided many years at Culiacan and other places, but settled themselves, and called their city Tenochtitlan, in 1324: it was afterwards named Mexico, and became an elective monarchy in 1377, Montezuma died in 1520; he was the ninth king, and was descended from the first monarch. Montezuma's ancestors had arrived in *ships* under the command of a mighty lord, but whether by design or accident was not manifest *.

Guatemala had been conquered by Ahuitzotl, the eighth king of Mexico, who died in 1502.

Regarding the ruins at Palenque, says Baron Humboldt, "they are evidences of the taste of the Toltec and Aztec race for the ornaments of architecture. We are absolutely ignorant of their antiquity, but it is scarcely probable that it goes back farther than the thirteenth or fourteenth centuries of our era."—*Researches*, ii. 158.

* Speech of Montezuma to Cortez. See Peter Martyr in Hakluyt, vol. iv. 558; Quarterly Journal of Science, January 1828, p. 359. Montezuma is an Asiatic name. The earliest writers, Peter Martyr, Purchas, Herera, Clavigero, (see Portrait, vol. i.), and others, spell the name *Motezuma*, and zin was added. Moti is a Chinese name, (Du Halde, vol. i. p. 197, 203). and is also the name of the Emperor of the Kin, or Nioutches, (D'Herbelot, Canon Chronologique, iv. 276), who are Mongols, (Abul Ghazi, ii. 383.) *Tscoum* means *venerable*, (D'Herbelot. iv. p. 349, lines 8 and 23;) *zin* means *great* in the Mogul language, (Abul Ghazi Bahader, part iii. ch. iv.) Thus the name is consistent with the dignity of this famous monarch, who told Cortez that his armour, jewels, &c., were those which he had preserved from his forefathers, as the usage of kings is.—(*Conquest by the Mongols*, p. 325.)

Regarding the Emperor telling Cortez, that the Children of the Sun expected bearded men from the *Rising Sun*, (*a*) or east; it could not mean Europe, as the Americans did not suspect the earth being spherical; and Japan is named Nipon, and in Chinese Sipon, both of which mean *basis or foundation* of the sun.

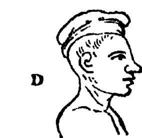
(*a*) Cabrera, page 60. This is the most important and principal mistake which has led this author, and many others, into their Carthaginian hypothesis. But Cortez, in his letter to the King of Spain, says—"I replied to all he had said in the way most suitable to myself, by making him believe your majesty to be the chief whom they have so long expected."—p. 62.



Two Calmuc Idols,
IAMANDAGA,

and

ERLICK-HAN.













Description of the Seventeen Plates which are published; but not bound in the same order in Two Volumes which the Writer has seen; they are, therefore, now numbered and described *so as to be easily referred to.*

I.—Is the largest plate, (fifteen inches by ten,) representing a Greek Cross, much decorated, with a bird perched upon it, with something like a branch in his beak. A man stands on each side of the Cross, one of whom is holding a figure of an imperfect or fabulous infant.

The borders appear to be registers of their victories, by the representation of heads, *hands*, and ears; accompanied with ciphers, to denote the numbers slain.

Remark.—The Toltecs left their native land, A.D. 544, and the leader of the Guatemalans was Votan. It has been shown what tremendous convulsions existed among the Turks, whose head-quarters were in the Calmuc country at that period *, (Turquestan.) The eastern nation, called the Eastern Ouie, had a sovereign whose name was *Voutim*, and he was poisoned in the year 543 †. Now it is quite probable that this is the same name as *Votan*, for D'Herbelot, from whom this is extracted, (vol. iv. p. 71,) uses *m* for *n*. Mongols he spells *Moumgols*, (see his Index.) The American tradition brings Votan from the north, (*Humboldt, Res.* i. 173. See also vol. i. p. 319, for the remarks of Baron H. regarding Votan: and also for the similitude of the border-registers of the Indians of *Chiapa* (Palenque) to those of the Mexicans.) The writer is averse to etymological proofs, but he does not deem this an overstrained one. With respect to the Cross, it was well known at this period in Tartary; the Turks and Huns warred with the Christians at Constantinople; and the Tartars of all descriptions ever called themselves descendants of *Noah*. At this epoch the Alcoran had not appeared. (Mahomet was born in 569.) These circumstances may very satisfactorily account for their knowledge of the Cross and the bird. The border-registers are in the style of those of the Mexicans, but not the same characters, nor so methodical ‡.

* Conquest of Peru and Mexico, p. 269.

† "From 439 to 589, the north of China was governed by Tartars, the south by Chinese. Never was history more fertile in great events than during that period of *brigandages*."—D'Herbelot, iv. 57.

‡ See Clavigero, Vol. i. p. 107.

The heads and ears are common with Mongols and Turks. The early Parthians cut off also the *hand*. The head and right hand of Crassus were presented to Arsaces Orodes.—(*Hist. Parthian Emp. by Lewis*, p. 111.) Thus all these customs and allusions may be referred to Tartary in the year 544.

II.—An ornament, probably in bas-relief—two human figures, one with an animal's head, rather like a wolf, two human arms and two eyes, as if plucked from a criminal. Another ornament of a female half-figure, with a helmet and necklace. This head has a high skull.

Remark.—The eyes prove this plate to allude to a custom common in Upper Asia. The Emperor of Bochara's eyes were put out, A.D. 998. *Dow's Hindostan*, i. 39.

III.—A man in a decorated kind of helmet-head-dress, with a weapon in each hand, upon one of which is a small bird: a human head is upon his girdle; another man is upon his knees, with his hands joined, imploring for mercy: they have both long or high skulls. The neat border to this plate is merely ornamental, by its uniform design.

IV.—A man in a helmet with a long necklace; a weapon in his right hand, and with the left holding another man by the hair, perhaps to behead him: the latter is seated. Under him is a skull, and a head which has been cut off. There is a register-border three inches long. Both of the men have long heads.

V.—Several large designs like border-writing; with one of them there is a human profile, with a ram's head upon the forehead.

Remark.—There were no sheep in America. Usbecs (*i. e.* Mongols) are distinguished by ensigns with black and white sheep. (*Sir R. K. Porter's Travels in Persia*, vol. i. p. xix.) The Peruvians and Siberians had figures of sheep in gold and in stone. The sheep was sacred with the Mongols in their sacrifices.—(*Marco Polo*, p. 253, *Conquest of Mexico and Peru*, p. 221.)

VI. A warrior in a large fanciful helmet, upon which is a human head, and two others upon his girdle; a decorated staff in his left hand, with a bird at the top of it: a net-work shoulder-covering, and a kind of buskins on his feet. Two slaves are seated at the feet of the warrior, with their legs crossed under them, and one of them with terror expressed in his features.

Remark.—These three persons, and nearly all the others represented in the seventeen plates, have remarkably high skulls and large aquiline prominent noses *; and some of them have projecting under lips. In a dissertation on this subject, (*Humboldt's Researches*, vol. ii. 130,) it is said, that " this is also the essential character of the hieroglyphical pictures preserved at Vienna, Rome, and the palace of the Viceroy at Mexico." The greatest resemblance to any known people is to the *Turks*. Among these plates the features of the man upon the medal in No. ix.†, may be those of a Calmuc; and many of the heads upon the *border-writing* of these pictures are rather flat than long. According to American history, the Toltecs left their native Tula, in Asia, A.D. 544, and being driven by famine from Anahuac, A.D. 1052, they settled in Guatemala and Yucatan.—(*Conquest by the Mongols*, p. 269.) From 506 to 545 Tartary was in the most convulsed state possible, and the Turks, whose head-quarters were near the sources of the Irtish, first rose to fame. This is *now* the head-quarters of the Calmucs. The Geougen Tartars resided at *Tula*, (near Lake Baikal,) in the year 520. In 555 the Turks had conquered all the north of Asia. Yakutz was named *Northern Turquestan*. Leao-tong was conquered, and they describe sledges drawn with dogs, as in Kamtschatka.—(Gibbon, ch. xlii. D'Herbelot, iv. 89, *et seq*. De Guines, vol. i. part ii. p. lviii. 352, iii. 7.) *The Turks had been the most despised portion of the slaves of the Great Khan of the Geougen;* but in a decisive battle the nation of the Geougen were nearly exterminated by the Turks about A.D. 545. The throne of Bertezena, the first leader of the Turks, the founder of which nation, like Romulus, having been suckled by a wolf, was turned towards the east, and a golden wolf upon the top of a spear seemed to guard the entrance of his tent. (A skeleton of a *coyote*, or American wolf, was found in a tomb in Mexico, in 1791, and there were in that city a chapel and a congregation of priests of the sacred wolf. *Humboldt, Res*. ii. 48. 319.) If we are strong, say the Turks, we advance and conquer; if feeble, we retire and are concealed.

* See two of these heads in the preceding plate, letter C.
† See the plate, D.

China was invaded by these conquerors. They besieged the *city* of Bosphorus, at Lake Mæotis, subject to the Romans. (*Gibbon*, ch. xlii.) About this period the northern parts of China were entirely ruined, the Emperor turned bonza, and by his weakness threw the country into the most terrible anarchy. (See *Du Halde*, cycle, A.D. 484 to 544.) Tou-men, chief of the Tou-kiue nation, entirely defeated the Kao-tche Tartars, and carried off half a million of families. Emboldened by this success, he sent an embassy to China in the year 532. It is quite impossible to trace the *persons* or the geography of these warriors, but it is evident that there are abundant causes for flight and emigration. (See *D'Herbelot*, iv. 92.)

With respect to the shape of the skulls, it has long been the custom, in Asia, to shape the heads of infants according to fancy or fashion. The midwives at Constantinople inquire of the mother, after parturition, what form she wishes to be given to the head of the child? The Macrocephali, (a people of Asia Minor,) or Long Heads, moulded the skull to as great a length as possible. (*Rees's Cyc. Cranium. Macrocephali.*) The Omaquas, in South America, press the head between boards till it is nearly sharp at top, and flat before and behind. Some of the Americans have flat heads, some protuberances behind, a strange custom, at length become hereditary. The Council of Lima, in 1585, expressly *prohibited these customs.* But the free negroes and Maroons, although Africans, have adopted it since they have lived among the Caribs, in order to distinguish the children which are born free. (*Enc. Brit. Macrophalus.*)

There appears to be some mistakes and erroneous notions regarding the persons of the Calmucs*. "The nose of the Calmuc is ordinarily *camus et écrasé vers le front* †, the head and visage very round. We are led to believe, from some travellers, that the Calmucs are ugly, and even hideous, but they

* See Rees's "Cyclopedia," Cranium, Mongolian variety.

† *This line of beauty* is accidental and does not generally apply. The writer of these notes passed a night in the house of a family in Finland, whose noses were thus deformed. The mother had a very young child lying upon her lap, and to free the infant's nose from its dripping incumbrance, she pressed it hard with her thumb upwards the whole length, and thus threw off the nuisance with a jerk, by which the child's nose was pressed flat, and the forehead, between the eyes, indented. She said it was the custom, and that they had no handkerchiefs. Thus, the poor classes of several northern tribes are disfigured.

are a good-humoured race, and some of the women are fair, affable, and so handsome, and have such regular features, that they would find numerous admirers in all the cities of Europe." —*Pallas*, 5 vols. 4to, tom. i. p. 496, *et seq*. If, in consequence of the Spanish decree in 1585, these deformations were no longer practised, nature would resume her true features, and we accordingly find that "the inhabitants of Guatemala are celebrated for personal beauty and sweetness of disposition, the women being reputed the handsomest in Spanish America."—*Rees's Cyc., Guat.* It was from the Oighours, in the part of Tartary in question, that the Emperor Kublai procured four or five hundred beautiful concubines annually.—*Marco Polo*, Note, 527.—*Wars and Sports*, p. 62.

If we seek the cause of the Tartars and Americans forming their skulls in different shapes, it may fairly be conjectured, that in the manner of the negro afore-mentioned, it became a custom, in order to enable the warrior to prove that he had exhibited an *enemy's* head, his own nation being distinguished by some other peculiarity. It is remarkable, that the Turks and Calmucs are of the same region.—See Humboldt on this subject, *Researches*, i. p. 126.

VII.—Two men, in highly decorated dresses mutually holding a jointed bent staff, about six feet long, (perhaps a bow) with a small human head at one end of it, and a head at the feet of each. They appear to be chiefs in earnest conference, as if pledging fidelity. They have long heads.

VIII.—Six large objects of border-writing, in which nothing is explicable, except a human eye and the cyphers which denote so many in number.

IX.—Two round brass medallic representations. The first is a large tree, with a huge serpent twined round it, and eleven objects, perhaps meant for fruit, among the leaves. A smaller tree, with six such objects. Another tree, with a bird perched above it, and four small trees, making seven trees. The second represents a man, with a cap, or turban, upon his head, naked, and kneeling upon a flight of several steps. A monstrous beast's head, with the jaws open, is seen before him, and another behind him, as if threatening to devour him. There are two trees, each with six of the fruit upon it, and four small trees, with part of another tree at the edge, making seven. The medal, says Dr.

Cabrera, (p. 54.) represents the expulsion of the Chichemacas from Amaquemacan, which is the city of Palenque, and not in the north of Mexico, or in Asia, as others have described. The seven trees represent the seven tribes*. The large tree is cieba, or wild cotton, with a snake twisted round it, which shows Votan to be a Hivite and the principal posterity of Cadmus. Votan had brought the first settlers, seven families, from Hispaniolia. Having visited Tripoli, he was surprised on his return to find that seven more tribes had arrived and blended themselves with the others who were of the same origin: and that they were named Nahuatlacas or Tzequiles, the latter being the name by which the Mexicans are known by the natives of Chiapa. (p. 95†.)

Remark.—This medal is, without any doubt, of Calmuc origin. The destroying beast is exactly the same that appears in the representation of the idols of Sungore, or Zungore, Calmucs. In that of Iamandaga, this beast is running, with a condemned Calmuc upon his back. In another, of Erlik Han ‡, he is trampling upon a wretched criminal. Iamandaga § is a destroyer, and is enveloped by a monstrous serpent, many yards long, the skin and claws of a tiger and other beasts, an elephant's head, and human limbs; he is crowned with skulls, and holds in one of his left hands, for he has six arms, and has upon his head likewise, a sceptre with a skull upon it, adorned with flowers, and a profusion of jewels, and a snake twisted about it ||. (Dr. Cabrera says, that Captain del Rio discovered in the Temple at Palenque, a figure of *Isis*, with a cap similar to that of Osiris, holding with both hands a twisted stick, adorned with flowers, having at one end a human head.—Page 44.) Erlik Han is sovereign of the infernal regions; he has the human body, with a hideous face, and *bulls' horns*, and there are three divinities above him, to represent the sun, moon, and stars,

* If the conjecture of Dr. Cabrera, that the trees relate to the seven tribes, be allowed, this medal is of the twelfth century. But it does not appear to the writer that the trees have any reference to the seven tribes. Medals were a part of the dress of a Tartar general.—Conquest by Mongols, p. 216.

† See Baron Humboldt's remarks on Votan, Wodan, Odin, of the Goths and Celts. —Researches, Vol. i. 173, 319.

‡ See the plate, B. § See the plate, A.

|| This is, in many respects, similar to the Mexican God of Terror, Tetzauhteotl, whose "body was girt with a large golden snake, and adorned with various lesser figures of animals, made of gold and precious stones. They never made war without imploring the protection of this god with prayers, and offered up to him a greater number of human victims than to any other of the gods."—Clavigero, i. 255.

who wear a head-dress in shape like a mitre. (Dr. Cabrera, page 38, describes an idol at Palenque, with a mitre, or cap, with *bulls' horns*, and says that, without doubt, it is Osiris.) So minutely do the descriptions of Dr. Cabrera agree with the figures in M. Chappe's volume, that he mentions a strap, or thong, with three ends, in the right hand of Osiris, and Iamandaga has precisely such a strap in his right hand *. This idol has upon his feet buskins, or *caligæ*, similar to those on the soles of the feet of several persons in these plates.

X.—A man, probably a divinity, seated upon a kind of throne, supported by two beasts like panthers, with his right leg bent horizontally before him, dressed in a helmet and feathers, a fringed apron, a necklace and wrist ornaments, a small portion of border-writing of a human head. This figure has the long or high skull.

Remark.—The Calmuc divinities are represented with one or both legs under them, generally like Bhudda, (*Chappe*, Vol. i. several plates,) but this is more probably a Turcoman idol; the Calmuc and Turquestan region being the same. This is the most civilised of all the figures. It has a kind of Persian elegance, like the Calmuc idol *Zouncaba*, in Chappe, Plate xxiii.

XI.—A full human figure, very fancifully decorated, the head of a bird over his head, and an instrument in his mouth, as if blowing it. Above the ancles, and at the wrists, it has ornaments round them; they appear to be composed of about twenty-five pieces of sticks or shells, three or four inches long, and close together.

XII.—A building, three stories of which are represented. They diminish in size at each story; the entrance is by doors: there are not any windows. The interior was filled with loose sandy earth. In the small turrets, at the top of the tower, there were two stones embedded in the walls, on which were sculptured two female figures, with extended arms, each supporting an infant, very imperfect, which appears to point out that this was the burial place of two queens. There were three crowned heads,

* See the accompanying engravings, copied from Vol. i. 303, 308, of Voyage en Sibérie, par M. Chappe d'Auteroche, 3 vols. folio. Paris, 1768. The third volume is a description of Kamtchatka, by Professor Kracheninikof. This splendid work contains very numerous fine engravings. It is called two volumes, but is bound in three.

represented with devices, like those of the Mexican kings. These circumstances, with Votan's history on the Medal, point out, as clearly as evidence can prove, that Amaquemacan is the Province of Chiapa, and not in Asia or the North of America.—Dr. Cabrera, p. 58.

Remark.—There is nothing in this tower to show a different architecture from the Peruvians and Mexicans. A fire-temple in Persia is of superior architecture, but has, like the above, only a door, and no window; and it is also accompanied with bas-reliefs and tombs (*Sir R. K. Porter's Travels*. i. 562.) The houses in Thibet have no windows, and are entered by a ladder, just like Casa Grande, built by the Toltecs, N. lat. 29° by California.

XIII.—A man highly and fantastically decorated; he has the long-head, armour upon his shoulders, jewels and ear-covers. His helmet is surmounted with a bird's head, with a fish in the beak; three more fish decorate the head-dress, as if for trophies; and there is in the border-writing an ugly, rather flat, head, with a fish upon it, to denote its nation or tribe *. There is a small idol, as a kneeling human figure, with a fabulous beast's head, and another such head at the girdle of the man; these heads are possibly meant for those of the wolf.

Remark.—The Persians name the natives of the ancient Gedrosia, *Mahiser*, or fish-heads, being somewhat similar to a marine monster, besides which they lived wholly on fish; (they are the *ichthyophagi*, through whose territory Alexander returned from India.) This country was conquered by Zagatai, son of Genghis Khan, in 1222. He destroyed the city of Tiz, and passed the winter at Quelanger, near the Indus; and as it belonged to Kublai, it affords a tolerably good proof that there were such troops with the Japanese expedition, and also of the modern origin of some of the people near to, or of Palenque. Kublai purposely weakened all his conquests by recruits for the reduction of China; and as he subdued that empire in one great battle near Canton, in 1280; with the surplus of his immense army he made the attempt on Japan, in 1283.—See *Bibliothèque Orientale*, "Mahiser." Petis de la Croix, p. 336. *Wars and Sports*, p. 508.

* See the plate, E.

XIV.—Ground-plan of a building, very simple.

XV.—A man in a helmet, seated; upon the seat there is represented a hand cut off. Another man in a helmet, a girdle in his left hand, marked with arrow-heads, and holding an instrument in his other hand, in an attitude as if to cut off the left hand of the man upon the seat. These have the long-shaped head.

XVI.—A circle, in which is a couch, or seat, formed of a quadruped, like a cat, with a head at each end, and at one end a human face, or head; a man sits upon the seat with his legs under him, and his right hand upon his breast; a human hand and some flowers are upon his head. A figure, apparently a female, kneeling, presents to him a flower-pot, with a plant in it; both of these have long-heads. There is some border-writing, among which are four human heads. Underneath, upon a stone, there is more border-writing, two small human figures, and one head.

XVII.—An ornamental front, or entrance to a building, decorated with two birds and two snakes. The design, on the whole, is not devoid of taste.

[To be continued.]

On the Presence of Chlorine in the Black Oxide of Manganese.

[By James F. W. Johnston, A.M.]

i. I digested the native black oxide with the sulphuric acid of commerce: an odour of chlorine was in a short time perceptible, and was discernible for many weeks on stirring with a glass rod.

ii. The brown oxide, remaining after preparing oxygen from the native oxide by exposing it to a red heat, was treated in the same way, and *with the same result.*

iii. Another portion of the same brown oxide was washed with repeated affusions of hot and afterwards with cold distilled water. On drying and pouring upon it concentrated sulphuric acid, the result differed in nothing from the former.

iv. An impure sulphate of manganese was precipitated by carbonate of soda; the carbonate, washed, dried, and heated to redness, gave a brown oxide, which, with sulphuric acid, afforded precisely the same evidence of the presence of chlorine. The odour was distinct, and the supernatant acid destroyed the colour of indigo. I found a few minutes sufficient to develop

it, both in this case and in No. iii., if aided by a slight degree of heat.

v. I threw down a *pure* carbonate from a pure muriate of manganese, obtained by Faraday's process. This was dried and partially decomposed by heating in an oven: with diluted sulphuric acid, it gave also the smell of chlorine.

From these experiments, we may legitimately conclude, first, that Mr. Mac Mullen was correct as to the *fact* of the emission of chlorine from the native oxide, which Mr. Phillips has called in question, for it is given off by *artificial* oxides, into which no trace of a muriate could possibly enter.

Secondly, that Mr. Mac Mullen was wrong in his *supposition* that the native oxide is, either in whole or in part, a chlorate of manganese; for the very supposition takes it for granted that this chlorate is decomposed by the sulphuric acid, and hence the origin of the chlorine. But after solution in sulphuric acid, precipitation by the carbonate and heating, if Mr. M. be correct, we have a chlorate still.

Thirdly, that these facts form no substantial ground for the further supposition that chlorine is a compound body. That it is not a compound, is supported by evidence that cannot be lightly passed over, and it is more safe to leave *one* point unexplained, than to venture a reason which is contrary to all the received doctrines of the science. Nothing is more easy than to find two atomic numbers, which, when added together, will make up a third; but a very wide induction of facts will be necessary to render the supposed combination even probable.

I thought it *possible* that, notwithstanding the incompatibility of the sulphuric and muriatic acids, a minute portion of the latter might be present in the sulphuric acid of commerce.—Into a portion of acid, such as I used in the above experiments, I poured a quantity of muriatic, but after the effervescence had ceased, and the acid had been gently heated, I could find no trace of muriatic acid remaining.

A prosecution of the inquiry, in regard to the oxides of lead, may throw some light upon an effect, which it is better in its present stage to attribute to the agency of some foreign substance, contained either in the oxide or the acid.

Claypath, Durham, 8th March, 1828.

Extracts from Lectures delivered at the Royal College of Physicians in May 1827, *founded by* Dr. William Crone, *chiefly on the Structure, Functions, and some Diseases of the Colon, with some Preliminary Remarks on Anatomical Knowledge, &c.* By G. D. Yeats, M.D., F.R.S., Fellow of the Royal College of Physicians, &c.

Although there is no part of the human body which does not present objects for deep and interesting inquiry to the philosopher and the anatomist, yet the more intimate connexion which some parts have with the life, the comfort, and the happiness of the individual, demands a closer and a more anxious investigation. There is no study, however engaging, no pursuit, however agreeable, which offers to the contemplative mind, objects more pleasing and attractive than the animal frame. From the deep research which has been employed upon it, the patient investigation it has undergone at different periods of anatomical history, in its structure, its actions, and the laws which regulate them, by professional men of high talents and knowledge, it can scarcely be expected that I shall be able to introduce any thing sufficiently striking to excite your feelings, or acquire your notice: particularly when it is considered that I address an audience whose minds are familiarized with every subject I can present, and whose pursuits have led them to similar inquiries, enhanced by their acquirements in science. But notwithstanding centuries have past away, during which much labour has been bestowed, and great ingenuity displayed in investigating the economy and structure of the human frame, yet it will be acknowledged that, although much has been performed, much still remains to be done; for, in our dissections of the dead, and in our investigation of the laws which regulate the living body, much novelty often presents itself to our view, which excites our surprise and perplexes our understanding. If we travel, therefore, in a beaten track we shall still meet with some objects which will create new ideas, and stimulate to fresh exertions: for, be it recollected that what is common is not always generally known, and what is known not always well understood; and that while we are pursuing our investigations some new diseases are budding into existence and others are falling away; and of those which remain many change their types, their symptoms, and their appearances, and require various modes of treatment in different seasons and in different climes.—Differre quoque pro

naturâ locorum genera medicinæ: aliud opus esse Romæ, aliud in Ægypto, aliud in Galliâ. (*Celsus.*)

A very attentive consideration, indeed, has been paid of late, but not more so, speaking generally, than at some former periods, of which any reader may soon satisfy himself by looking over the works of Hoffman, to the stomach and alimentary canal; yet the undistinguished manner in which diseases of the different portions of this canal have been treated, claims some inquiry; for the indiscriminate use of remedies in certain morbid conditions of this part of our frame, has not only been fruitlessly resorted to, but has evidently been attended with considerable detriment. It has been imagined that every case of dyspepsia, with a jaundiced appearance of the eye, has called for the necessary exhibition of mercurials, from the influence which a supposed morbid condition of the liver has in producing it, although, from inquiry, it would be discovered that such a state very often arises from causes on which mercury exerts a very unfriendly operation. Soon after our closer acquaintance with the East (where mercury is always very largely used, and where most diseases are traced to some morbid condition of the liver) had introduced a more frequent intercourse between that part of the world and Great Britain, the professional gentlemen, returning to their native shores, imported the eastern mode of largely exhibiting mercury. This instrument, from the strong representations made in its favour, was eagerly seized by injudicious hands, and was indiscriminately, and therefore incautiously wielded. In illustration of the opinion of how far an erroneous notion may be entertained respecting affections of the liver which do not exist, I may here mention a case of some importance in itself as connected with this subject which occurred to me many years ago. It was the case of a lady who was attended by an eastern physician for a supposed disease of the liver; he had known her in India, and she had taken a good deal of mercury at different times. I was called in about a week or ten days before she died. I ventured to say, that, although I could not tell what was the precise nature of the complaint, there was no organic disease of the liver. On opening the body after death, which was done at my particular request, the liver was discovered quite sound; death appeared to have been caused by some disease of the spleen, which was extremely soft, and blood was found effused in its substance from ruptured vessels.* The death was rather sudden.

* The case was attended by the late Dr. Dick and Mr. Andrews of Charing Cross.

It is not intended to deny the influence which the liver possesses over the intestinal actions by the superabundance, the deficiency, or the morbid quality of its secretion; but the diseased impression, which is made upon this great gland by irregularities in the tortuous tube of the intestines, has not been sufficiently ascertained, or properly appreciated. It is, in many cases of the latter kind, accompanied by what are called bilious symptoms, that an injudicious resort has been had to mercury, the value of which, however, as an excellent remedy in various kinds of cases, I am at the same time not at all inclined to depreciate, as I shall have occasion to mention during these lectures. The control which the intestinal actions exert over the feelings and the comfort of the individual, the harassing and distressing sensations in the body which arise from their morbid state, would, at any time, direct our attention to a consideration of the diseases which affect this tube, either in its separate divisions or in the whole as one continued substance. An oppressed stomach, from the superabundant quantity or vitiated quality of its contents, a torpid state or irregular movements of the intestinal canal, a congestion of their vessels, or an imperfection in the nervous energy there, with or without morbid structure, will produce irritability of mind in different grades, from simple eccentricity of conduct and confusion of ideas to complete insanity. Morositas illa ac ægritudo, quâ homo sibi aliisque oneri est crebro ex malâ ventriculi conditione oritur (Soemmering.) However trite then the subject may be, however beaten the path, which has been gone over, no attempt should be considered superfluous on any matter, until that matter be brought to all possible perfection, more especially when the greatest of all blessings, health, both of body and mind, is intimately connected with the subject.

Having, in the spring of 1817, delivered the Gulstonian lectures on the structure, functions, and diseases of the Duodenum, extracts from which are published in the sixth volume of the Transactions of the College, and the public having been pleased to stamp some value on the hints I threw out respecting them, I avail myself, being called upon to deliver the Cronian lectures for the present year, of the opportunity to offer to your notice some observations I have made on the structure, functions, and some diseases of the Colon; being convinced by experience that as certain morbid conditions of the Duodenum have been treated as affections of the liver, so have some deviations from healthy action in the colon been improperly treated as a dyspeptic state of the stomach; it being recollected that the great arch of the former

lies close upon the latter, and that a swelling or puffiness in the one may be easily, without due care, and has often been, attributed to the other. I take that opportunity to state some priority of claim I have in my observations on the duodenum before Dr. J. Hamilton, jun., of Edinburgh, because some of the periodical journals have asserted that Dr. Hamilton had preceded me in this field of inquiry in an excellent work which he has published. The dates will show the reverse. Many similar ideas are entertained in both these publications without any communication having previously taken place between the authors; thus giving confirmation to the correctness of the statements, and stamping a greater value upon them. I read the Gulstonian lectures before the College in May, 1817; and the extracts from them were published in the Transactions for the year 1820. Dr. Hamilton's book was published at Edinburgh in 1819. Thus the Gulstonian lectures were delivered two years before Dr. Hamilton's publication made its appearance.

It is a usual and a good rule to give an anatomical description of the parts, the functions, and diseases of which it is intended to detail—it brings the whole subject more completely within the mind's eye; and whatever connexion there may be between the structure, functions, and diseases, such connexion is brought more directly under our consideration. But whatever amplification our knowledge may derive from the study of anatomy, whatever precision it may give in the detection of the locality of disease, yet an intimate acquaintance with minute anatomical structure is not so essentially necessary as it appears to the successful practice of physic: for it does not make the physician at all acquainted with the effects of remedies in the proper treatment and alleviation of disease. Did our knowledge of the minute structure of the kidnies, or of the absorbent system, lead to the use of calomel, of digitalis, or of the different salts, as diuretics? What analogy have we discovered between the internal coat of the intestines and the effects of jalap, of scammony, or rhubarb, or aloes, notwithstanding the excellent knowledge we have derived from the labours of Peyer, of Malpighi, of Lieberkuhn, and of Brunn? What between chylopoetic derangement and blue pill? between squill and certain diseased states of the thoracic contents? Is there any thing in the structure or appearance of the nerves which leads to the use or the knowledge of the effects of opium? You will look in vain to the same quarter for any thing which would teach you the use or effects of belladonna, of stramonium, or of colchicum. In viewing

the geographical map of a country, we see its cities delineated, its rivers, mountains, and valleys painted in different colours, its various districts described and defined, but we gain no knowledge therefrom of the customs, polity, and laws by which the inhabitants are governed. The same observation will apply with equal force to anatomical knowledge. We may be well acquainted with the structure of the different viscera, with the position of the glands, with the distribution of the blood-vessels, and the course of the nerves; but such knowledge however deep, such research however recondite and laborious, will not teach us how the functions are performed, or become deranged, nor upon what principles the secretions are elaborated. We can raise no superstructure upon this basis explaining the cause and effects of nervous energy, or of the phenomena of healthy and diseased actions. The body is the mere machine upon which the vital laws act; it affords no knowledge of the nature of them. The physician can only gain this by experience, observation, and long inquiry, and by that habit of just reasoning, which, derived from a liberal education, is applied to the patient investigation of symptoms. The knowledge of the nature and effects of remedies preceded the knowledge of anatomy; and some of them indeed still remain, from the earliest ages, recorded as valuable in our materia medica. Well has an ingenious friend of mine observed, it would seem that anatomy is to the science of physic what arithmetic is to algebra; we must know individuals and their combinations before we can abstract, and though a very important branch, is only one of the many which compose the tree: in fact, after many years employed in discovering what anatomical pursuits can do in the progress of the healing art, we have also discovered what it cannot do, and the result will lead us back with some profit indeed to the patient investigation of symptoms and their remedies.

Soon after that valuable discovery which has deservedly immortalized the name of Harvey, a new impulse and direction were given to the investigation of disease. The physicians busied themselves throughout Europe by multiplied experiments on dead and living animals to discover the causes and effects of the healthy and morbid conditions of the body. As long as they confined themselves to the facts they witnessed in the different structures of the body, and in detailing the different appearances they discovered, considerable addition was made to sound and useful learning; but a mechanical mode of explanation soon arose, in accounting for the phenomena of the diseased and healthy functions, which led to the most absurd

conclusions, even in the able hands of Bellini, of Pitcairn, of Borelli, and of Keil. Forgetting the modifications and changes produced by the vital powers, they applied their mechanical ideas to the living as to dead and inert matter; hence the contradictions in their philosophical computations. For example, we are told by Borelli, that the heart overcomes a weight equal to 180,000 pounds in propelling the blood through the arteries; by Hales, to no more than 51 pounds; while Keil makes the resistance only equal to one pound, although he computes the fluids in the human body to be five times more in quantity than Borelli. The same conclusions, alike repugnant to fact and to experience, are drawn respecting the quantity of bile secreted by the liver; and yet they all appeal to mathematical demonstrations for proof; for example, Borelli first measures the diameter of the ductus communis choledochus, which he finds to be the 225th part of the diameter of the vena cava, just before its entrance into the right auricle of the heart; supposing the whole mass of blood to be 20 pounds, and to circulate 16 times every hour, there would circulate 7680 pounds of blood in 24 hours; hence Borelli infers, that if 7680 pounds of blood pass through the vena cava in 24 hours, the 225th part of this quantity, *i. e.* 34 pounds of bile, must, in the same space of time, be transmitted through the hepatic ducts, (Percival's *Essays;*) but mark how a plain fact puts down all this mathematical reasoning about the quantity of bile. Reverhorst ascertained by experiment, that if a tube be inserted into the gall-duct of a large-sized dog, the bile flows at the rate of about two drachms every hour, making six ounces in 24 hours; hence he calculated, that with man, who is of greater bulk of body, with a larger liver, and, consequently, with more numerous vessels for the secretion of bile, there would flow in 24 hours about nine ounces, instead of 34 pounds. (*Dissertatio Anatomico-medica de Motu Bilis.*) This mechanical doctrine, which served more to gratify philosophical pride than to afford useful instruction, bids fair to be revived in the passionate propensity which at present exists for explaining every thing from the appearances in morbid dissections. Soon after the publication of Morgagni's *Adversaria*, and of his work *De Sedibus et Causis Morborum*, evincing a mind indeed gifted with high talents, and capable of patient and laborious investigation, the mechanical mode of inquiring into and accounting for disease made great progress; and in this country additional interest has been given to these pursuits by the publications of the late justly-esteemed and lamented Dr. Baillie. The path which he had tracked has been since

trodden, and is still followed by others, without, as far as I am able to see, much beneficial result of practical utility in the alleviation of pain, and mitigation of disease. The desideratum in his *Morbid Anatomy*, and in most similar works, is a detail of the symptoms which preceded and accompanied the morbid condition of the parts when living; and even with those where the symptoms have been detailed, I scarcely find that the knowledge of those symptoms, with the appearances after death, has suggested any remedial means for that which the dissection has discovered. The seat of pain, too, is not always the seat of the disease producing it. Look at the painful affections of the head, arising from a diseased stomach; at the morbid condition of the stomach and liver, produced by excitation of the brain; at the pains of the back, consequent upon various diseases of the abdominal viscera; at the uneasy state of the stomach, too, connected with organic disease of the heart, with many other examples familiar to you all; and you will have an illustration of this observation. Of the latter example, the case of a great law officer, whom I several times saw before his death, is a very strong instance. He laboured under angina pectoris, as dissection afterwards proved; but he always persuaded himself that his complaint was in the stomach, and that if he could get rid of his disease there, he would be well. The coronary arteries were ossified, and the preparation is in the museum of this college. I had warned his family of the nature of his complaint, and that he would die suddenly; and so it happened. A morbid state of the stomach long continued will lead to various diseases, to those of the liver, to apoplexy, palsy, phthisis, affections of the skin, &c. Dissection will not tell me how these various effects are produced, nor how they are to be obviated. The first traces of morbid symptoms are to be counteracted by different proceedings long before those effects are produced which morbid dissection exhibits: for the consequences require a mode of treatment very opposite to that by which the original causes are to be combated. In fact, those effects are, as it were, conversions from one disease into another, so that what we see in dissection is a different disease from that primary one which the symptoms originally pointed out. A great deal of interesting matter on this subject is to be found in Hoffman *de Morborum Transmutatione*, in Baglivi, and in an ingenious paper of the late Dr. Ferriar on the Conversion of Diseases. Morbid anatomy, it is true, confirms to us what we learn from the symptoms, viz. that irritation in one organ will often produce disease in a distant one,

and this is important and useful information; but we only see the effects produced, for we must be guided by the symptoms in the living body what means we are to employ to counteract the tendency to produce these effects; and these we learn from experience, and from patient and discriminating observation. I do not complain so much of the minuteness to which these dissections are carried, as of the unnecessary importance which is given to them in a practical point of view. We find great labour bestowed to trace a brown, a white, a yellow, a hard, and a soft tubercle of the liver, but no practical indications of utility are derived therefrom. If there be a polypus in a ventricle of the heart, or an ossification of its coronary arteries, or of its valves, or of the chordæ tendineæ, or of the muscular substance itself, however it may gratify philosophical curiosity to know the minute discrimination of local symptoms during life, or the nice distinctions in the morbid appearances after death, we gain thereby no curative remedy; and although we should be able to ascertain whether the peritonæum of the duodenum, of the jejunum, or of any part of the abdominal contents be inflamed, it leads to no difference of treatment. If the lungs be thickened or compacted like liver, or are tuberculated, what avails the knowledge when it does not lead to anything which can soften the one or resolve the other? A great deal of valuable time is lost in making those nice distinctions which would be better employed in endeavouring to discover means to counteract the causes which lead to the consequences.

It is far from my intention to insinuate that these studies are altogether useless, that the knowledge of the condition of morbid parts is no acquisition, though certainly not one of that utility which is generally believed, and I deprecate the ultra-importance attached these pursuits.

In certain diseased symptoms, within the thorax for example, arising from a collection of fluid there, we know that digitalis, calomel, squill, neutral salts, &c. will often relieve the patient of this morbid load; but unless we had had a previous knowledge that medicines of this class counteracted the effects which these symptoms indicate, no morbid dissections, however numerous, discovering effused fluids, could have suggested any medicinal means for their removal. Morbid dissections, by discovering diseased structure, will often mechanically and beautifully explain and illustrate the phænomena which had occurred some time previous to dissolution; but they afford us, in general, little or no information of the causes and nature of the symptoms which lead to the effects producing

these phænomena, and consequently leave us in the dark as to that great object, a remedy to counteract them.

They, therefore, seduce the student, and are made to supersede clinical inquiry into the effects of remedies on the modifications or counteraction of symptoms, by which alone a practical physician can both do credit to himself, and become essentially useful to the community; by which a Sydenham and a Heberden rose to merited fame, and bequeathed in their observations a valuable legacy to posterity. The examination of morbid parts did not teach the former the cool treatment of variola, nor the propriety of bleeding in the diarrhœa after measles; neither is Hippocrates indebted to the same source for the correctness of his aphorisms. We observe in persons who die of fever, the ravages committed by its violence on the brain, the liver, the spleen, and other organs—they are the effects of the storm which has raged, and which has uprooted the vitals of the constitution—this destruction of parts shows us how certain symptoms will terminate by diseased structure in death; but assuredly this destruction did not suggest to the philosophic Currie that beautiful theory, nor the reasoning upon it, which led to the successful cold affusion in fever. Well has the author of the *Gold Headed Cane* observed, "For strange as it may appear, notwithstanding the estimation in which the works of this great ornament of physic (Sydenham) have been always held, he made no powerful impression himself upon the general state of medicine, nor diverted in any material degree the current of public opinion from its former channel. The mathematical physicians who succeeded him, invented new theories more captivating than any which had hitherto appeared, and the full effect of the example of Sydenham was for some time lost in the seductive influence of visionary speculation," founded, I will add, on the mechanical doctrines. I am, therefore, anxious to put the younger part of the profession, and the student who is working his way to the practice of it, upon their guard against too sanguine an expectation of practical utility from such pursuits.

We know from experience and observation that a certain assemblage of symptoms will indicate a tendency to premature death, and it is of no consequence, in a practical point of view, whether dissolution take place from the destruction of the brain, the liver, or any other organ, provided we can obviate the cause; and in fact, during the disease, fever for example, we do not always know which organ will be destroyed, and perhaps no one in particular may exhibit the appearance of disease, though death shall ensue. The morbid ap-

pearances are the effects of preceding causes, and a biassed contemplation of such effects has not unfrequently led to erroneous practice; this was certainly long the case with respect to hydrencephalus, which was always treated as dropsy till very recently, because water was found in the ventricles of the brain*. The reputation of a modern celebrated surgeon in managing dyspepsia, certainly does not arise from his anatomical knowledge, great as it is, but from his acute observations on the laws which regulate the economy, and on the consequences which follow a morbid condition of those laws; and the brilliant success which has marked the professional career of our distinguished President, exhibits the advantage of that happy union of philosophy and medical knowledge which refines the understanding, and chastises the mind into a judicious discrimination of the symptoms of disease. It has been well remarked, that without an alliance with literature, there is often something illiberal that clings to the sciences. In medicine, the want of this alliance is every way disastrous—it not only shuts out the fairest paths of science in the origin and progress of professional knowledge; but degrades the mind itself, which, when it wants the cultivation of learning, wants that which would temper its efforts, rectify its judgment, and civilize its habits.

The idea that a minute knowledge of the anatomy of morbid parts, coupled with mechanical explanation, will produce successful treatment, has rapidly advanced manual tact into the regions of physic, without improving our curative indications. This delusive impression has introduced further mechanical proceedings; and now, in addition to applying the hand to every pained part of the body, we must employ instrumental examination, and endeavour to gain an acoustic knowledge of the state of parts by mediate auscultation with the stethoscope—thus gauging the depth, measuring the length and breadth, taking the latitude and longitude, diving into the density of thickened parts, and circumscribing by chart and by scale the extent and dimensions of adhesions and of fluid extravasations—a proceeding derogatory to medical philosophy, and not so beneficially useful in its ultimate practical application as the praises bestowed upon it would lead us to believe. The student will be led astray from the pursuit of objects more becoming one who is to enter upon the practice of his profession with an understanding formed by philosophy and literature. Instead of a judicious and patient attention to the assemblage of symptoms so complicated in morbid sympathies, he will neglect clinical lectures, which have un-

* See the Author's Statement of the Early Symptoms of Water in the Brain. 2d edit.

fortunately declined of late, for morbid dissections, expecting every thing to be developed at the point of the scalpel. Qui ergo inter sepulcreta anatomica diu defixus, e cadavere quovis inerti et defuncto, actionum quorumcunque animalium causas intimiores, utcunque audacter, frustra tamen eruere tentat—Frustra per mortem ipsam, ad vitam illustrandam progreditur, omnes nodos cultro solo rescindendos esse frustra jactitat, ac velut augur exta consulens pro deorum effatis frustra commenta reportat sua. (*Dissertatio*, &c., *à Thoma Okes*, init. 1770.) I trust I am not understood as meaning to depreciate the utility of anatomy, as intending to undervalue the exertions of those who have worked, and are still working in this fatiguing and fruitful field of inquiry. We are much indebted for information to the patience, the talents, and the industry of those who have given such anatomical accuracy to the splendid achievements of the artist in his graphical descriptions which have issued and are still issuing from the press.

The minutest knowledge of anatomy is indispensably necessary to the practice of surgery; and a most accurate acquaintance with the different appearances between healthy and diseased structure, is equally indispensable to the forensic physician, or the one who studies juridical medicine; but even here, this knowledge, however deep, will often not avail the latter at all without the aid of that medical philosophy to which I have alluded; for some active poisons leave no traces behind them of the mode by which they have accomplished the destruction of life; and even where traces of deranged structure are left, this change is so similar to what sometimes occurs without the violence producing death, as to make the argument upon the morbid appearances of little or no weight: here the philosophical mind, tutored by clinical observations in the discrimination of symptoms, is of the first importance. This brings to my recollection an anecdote of the late Dr. Baillie. A person, whose life had been insured at one of the Life-offices, had died rather suddenly, it was said of apoplexy with convulsions; a phial containing some laudanum was found near him. The managers at the office suspected he had destroyed himself. The history of the case was drawn up and sent to Dr. Baillie; he returned it with the answer that he could give no opinion on the subject, as he had never seen a person die under the influence of laudanum.

Some years ago, I was subpœnaed to give my opinion respecting the cause of the death of a young woman, who had been severely kicked on the region of the stomach by a man. She was never well from that time to the day of her death, which happened several

months after, and she frequently vomited blood. On opening the body after death, the internal coat of the stomach was discovered inflamed. During my examination, I was asked by the court whether the appearances would not occur without the ill-treatment she had received; upon my affirmative answer, that such appearances sometimes occurred from constitutional causes, the judge directed the jury to acquit the prisoner, who was on his trial for murder. Dr. Yelloley's excellent paper on this subject was not then published. *Medico-Chirurg. Trans.* Vol. iv. p. 371.

The absolute necessity of a previous knowledge of anatomy to the judicious practice of physic, is apparent at first sight, and needs no illustration, yet the most accurate acquaintance with it is insufficient to explain the phenomena exhibited in the animal body; the study of physic is the study which qualifies a man for being a physician. He should be acquainted with midwifery and surgery, for the study of physic includes these, though not for manual practice: but this is not a dissertation on the qualifications and duties of a physician. The subject is a very interesting one, particularly at the present period, but any further indulgence in it would be a departure from the matter of these lectures.

Proceedings of the Royal Institution.

The weekly evening meetings of the Members of the Royal Institution were resumed for the season, on Friday, the 25th of January. On this occasion the subject brought forward for illustration was the discovery of the vegetable salifiable bases, and more especially of those alkaline substances which form the active principles in opium, and in the different species of cinchona. Mr. Brande observed, that these discoveries were not only curious as chemical investigations, but of the highest importance in their applications to medicine; he traced the history of the discovery of morphia, or the active principle of opium, and gave the credit of its discovery (and of the train of inquiry dependent upon it, so ably followed up by Pelletier and Caventou) to Sertuerner. The methods of obtaining morphia were described, specimens of it, and of some of its salts, were exhibited, and the properties of narcotine, another proximate principle of opium, but not salifiable, were adverted to. These investigations were chiefly dwelt upon as being the origin of subsequent discoveries in this difficult department of chemistry; but Mr. Brande observed, that in regard to their practical application

to medicine, they were infinitely less important than those connected with the different kinds of Peruvian bark. Of this drug three varieties are directed to be kept for medical use, in the London Pharmacopœia. The cinchona lancifolia furnishes *pale bark;* the cinchona oblongifolia, *red bark;* and the cinchona cordifolia, *yellow bark.* From the first of these Messrs. Pelletier and Caventou obtained the peculiar vegetable-alkaline, or salifiable base, called *cinchonia;* it is crystallizable, intensely bitter, and forms distinct salts with the acids: from the last they also procured a distinct base, called *quinia;* it is not crystallizable, but forms several salts that are so, and which, like the former, are characterized by intense bitterness. The red bark contains both cinchonia and quinia. Specimens of these substances, and of their principal salts, were exhibited, and the modes of obtaining them described and illustrated. The compound which has gained most celebrity, and which, indeed, is a truly valuable addition to the Materia Medica, is the sulphate of quinia. Mr. Brande said, that he thought cinchonia and its salts had scarcely been fairly tried. The adulterations of sulphate of quinia, and the means of detecting them, were next adverted to, and the discourse concluded with some general remarks upon the chemical analogies existing among these vegetable proximate principles; among these were particularly noticed their very high equivalent numbers, and feeble saturating powers,—their general medical activity,—the insolubility of their compounds with gallic acid,—their difficult solubility in water, and comparative solubility in alcohol, and their existence in the vegetables whence they are obtained, in combination with peculiar acids which have been but little examined.

Some specimens of the lately-discovered electro-negative element, called *bromine*, were laid upon the library table: also experimental illustrations of rotation; there were also curious specimens of artificial flowers, manufactured by the Brazilians from the scales of fishes; and a variety of novelties in French and other foreign literature.

February 1st.

Mr. Faraday gave a series of illustrations of the new phenomena produced by a current of air, vapour, or any other fluid, which have recently been observed by M. Clement, and experimented upon by him and other French philosophers.

We refer our readers to the abstracts from the papers of MM. Clement and Hachette, in vol. i., p. 473, and vol. ii., p. 193, for some account of these phenomena, in which also the forms of apparatus well

calculated to show the effect, are given, and the true theory stated. The effect in question is easily shown by making a small hole through a flat smooth bung or piece of wood, inserting a tube formed of a quill, so that it shall not project on the smooth side beyond the surface; then sticking three pins perpendicularly into the cork or wood, at about three-quarters of an inch distance from the quill hole, for the purpose of loosely confining a round disc of card or paper, which is to be laid over the hole. In this state of things, if the mouth be applied to the end of the quill, and an endeavour be made to blow off the disc, it will seem as if the latter were urged in opposition to, and pressed *against* the current of air; adhering consequently to the surface of the cork or wood, and, by covering the aperture, tending to stop the hole, and prevent the passage of the air.

The cause of the effect exists within the space between the two flat surfaces, and was said to depend upon the momentum communicated to the particles of air, which tended to make them move with equal velocity from the centre of the space between the two discs, to that part corresponding with the circumference in the direction of radii; but as the air, under these circumstances, is continually passing from a smaller to a larger space, the tendency to preserve its velocity must cause a partial vacuum, so that, except in a direction opposed to the course of the radiating current, the pressure, or rather resistance, of the air between the two discs in these parts, is less than the pressure of the atmosphere. Just at the centre of the disc, the force of the current of air passing down the tube is *added* to the elastic force of the air there, and the two together are *greater* than the pressure of the atmosphere on the opposite side of the same part of the disc: but as the disc is governed as a whole, not by the forces upon any one part, but by the *means* of the forces acting upon its two faces, so it will move from or towards the fixed surface, according as the mean of the forces exerted upon its inner face is greater or less than the uniform pressure of the atmosphere upon its outer surface. Now, although at the centre of the disc the force acting perpendicularly upon the inner surface is greater than the pressure of the atmosphere; that excess is more than compensated for by the diminution (dependent upon the momentum of the air, as already described) of the forces acting in a similar perpendicular direction upon the more extensive parts towards the circumference; and the mean of all the powers is found to be less than the pressure of the atmosphere, consequently the latter has the predominance, and the disc is urged against the

course of the central current. This is exactly the same explanation as that given by M. Clement.

The general effect was first illustrated by the use of some of M. Hachette's small mouth tubes *, and afterwards by a large glass apparatus, into which air was thrown by a pair of forge bellows, and by which discs, from six to eight inches in diameter, were supported in the air, although unsustained from beneath, otherwise than by the causes already described.

The state of the forces in different directions, relative to a current of air moving in the atmosphere, was then shown: the constant force of the pressure of the atmosphere is increased before the current by the added force of the stream of air, but it is diminished at the sides and behind, because the force of the currents is *from* those parts; and part of the elasticity which, whilst the air was quiet, was sufficient to oppose the pressure of the atmosphere, and retain all at rest, is now opposed and neutralized by the force of momentum; consequently the air of the neighbouring parts is urged in from the sides and behind, and made to move with the current. Screens or other light substances interposed in the way of the moving air, show by their direction in which way the air is forced; and some curious effects may in this way be obtained. Two pasteboard screens, about six inches square, being suspended parallel to each other, at a distance of two or three inches, move towards each other, and seem to attract each other forcibly when a stream of air is blown from the mouth through a small pipe between them. If a screen, having a hole in the middle, be hung about an inch from the end of an open cylinder, and a small pipe be inserted, an inch or two through the hole, but not touching it, into the cylinder; immediately that a current of air is blown through the pipe, the screen closes upon the open end of the cylinder, and may actually, by altering the position and continuing the current, be suspended in the air, and sustained against the cylinder; not by any impulse of the air blown through the pipe against the screen, but solely from the tendency of the air behind the jet to *follow* the stream. If the jet of a blowpipe be introduced an inch or more into an open tube an inch wide, and four or five inches long, and then, whilst a stream of air is forced through it, the flame of a candle or lamp be brought to the mouth of the tube *behind* the jet, the whole of the flame, though a large one, will be forced into the tube, by an entering current of air, which owes its existence

* See Quarterly Journal, New Series, vol. ii. p. 193.

entirely to the diminution of the force of the pressure of the atmosphere in the direction opposed to the current.

Another illustration of the effect was given, intended to lead directly to a clear understanding of the phenomena of the original experiment. A tin cone, about eight inches long, and three inches diameter at the base, had about half an inch in length cut off from the apex, so as to leave a small aperture there ; a round hole half an inch in diameter was made in the side, about four inches from the narrow end. Upon blowing forcibly into this cone from the narrow end, the current of air continually passed from a smaller to a larger space, and on bringing a flame to the lateral aperture, the whole of it was urged into the cone, and could be seen by looking in at the mouth of the instrument. By pressing this instrument into a flattened form, it was then shown to be an exact representation of part of the original tube apparatus, and the relation of the effects in both at once simply referred to the same cause.

M. Clement's experiment, in which he measured the forces perpendicular to and between the discs, by means of gauges, were then referred to *, and also several other forms of the apparatus, as well as other effects dependent upon the same cause. Mr. Faraday also referred to the supposed explanation of the original effect given by those who attribute it to the friction of the air, or to the current which sets in all round upon the original current of air. Friction can have nothing to do with it, because the force which supports the discs may be resolved into one perpendicular to its surface; whereas friction can only be at right angles to this direction. With regard to the influx of air, by which the effect is supposed to be produced, it is itself an effect only, produced by the same cause as that which supports the disc, and which may easily be distinguished from it. In place of using a disc, it was shown, that if a cylinder of the same diameter as the disc, and closed at one or both ends, had the closed end applied in place of the disc, it was equally well supported, notwithstanding it might be many inches in length. It was also shown, that when the influx of the neighbouring air upon the disc was allowed, *two* discs might be supported instead of one. The one by the causes already described, the other by the sweeping of the neighbouring air over the disc as it passed on, to follow the direction of the stream originally put in motion.

Dr. Granville laid several curious objects upon the library tables :

* See Quarterly Journal, New Series, vol. ii.



amongst them were the skull of an Ashantee slain in the battle of August, 1824, brought by Captain Martin, with two occipital bones; two quivers, with poisoned arrows, and two bows; the arms taken from the enemy on the same occasion, and a collection of wrought and polished specimens of the hard stones from Catherinsburgh in Siberia.

Mr. Lingard exhibited and explained his drawings and illustrations of the Natural History of Fungi and of Dry Rot.

Pohl's fine engravings of Brazilian plants, with several presents of books, were also laid upon the tables.

February 8th.

The subject this evening, on the Architecture of St. Paul's Cathedral, was taken up by Mr. Ainger.

The object of the lecture was to show the inapplicability of Greek architecture to the complicated buildings required by modern society, and more especially to those in which the arch and the dome formed important and conspicuous parts.

The origin of Greek architecture was explained on a dissected model of part of the Parthenon, in which the derivation of the several parts of the entablature, namely, the architrave, frieze, and cornice, with the tryglyphs, and mutules, from the timbers which composed the roofs of the Greek temples, was clearly shown. It appeared, therefore, that the entablature (which, with the column, constitutes what is called an *order*) is merely the representation of the edge of the roof, and therefore that it cannot, with propriety, admit any superstructure, but must always terminate the building to which it is applied, and that it must be confined to the exterior.

The principle thus obtained was applied to the interior and exterior decorations of Saint Paul's, which consist of imitations of this roof, placed at various heights within and without the building, in places where it is obvious they do not represent the edge of an actual roof, and where it is impossible they could do so. Various criticisms on the architecture of St. Paul's were adduced to show that these imitations of the roof, these copies of the Greek entablature, were considered as if they actually could and did conform to the types from which they are derived, the absurdity of which is rendered evident by the circumstance, among others, of their being *within* the building, and not half way towards its visible summit; in places, therefore, where their supposititious elements could not by any stretch of imagination be fancied to exist, and where, by attempt-

ing to give the expression of a wooden building, they contradicted that idea of difficulty, stability, and strength which would be suggested by an unprejudiced contemplation of the edifice, as composed of massive stone piers and walls, surmounted with stone vaultings.

From this it was argued that Greek architecture, or Roman architecture, which is its offspring, could seldom be consistently applied to the decorations of modern buildings; that the only instances in which Greek architecture could be appropriate, were those of simple porticoes not placed against a higher structure, as at Covent-garden theatre, but where the portico, with the pediment, formed the natural termination of the edifice, and of its roof, as in the church of St. Paul, Covent-garden, and as was universally the case with the Greek temples. It was contended that the departure from the natural use of the order, as bequeathed to us by the ancients, had been the means of introducing anomalies into the art which had depressed architectural science to the condition in which it now exists, and which had sanctioned the perpetration of every degree of ugliness and absurdity under the shelter of Greek associations.

Master George Noakes, the young lad, now ten years of age, so remarkable for his calculations and knowledge of figures, was present in the library, answering numerical questions; and in illustration of his method, thought aloud, or, in other words, wrought his operations audibly.

On the tables were placed models of Thorold's reel, for communicating with stranded vessels from the shore—Hockey's improved log-ship—Specimens of embossed black marble, and another of pearl, by Mr. Pearsall, the original inventor of the processes by which the effects were produced—and presents of books.

February 15th.

The subject this evening, in the Lecture Room, was on Resonance, or the Reciprocation of Sound. It was delivered by Mr. Faraday, who, however, gave all the credit belonging to the illustration, and the new information communicated, to Mr. C. Wheatstone. It was illustrated by some striking experiments, by many curious instruments of music from Java, for the loan of which the Institution was indebted to Lady Raffles; and by some very novel and curious musical performances on the Jew's-harp, by Mr. Eulenstein. We refer our readers to the paper at page 175, of this number, for a detailed and scientific account of this subject.

The Library contained numerous objects of interest. There were

upon the tables, and round the room, a collection of beautiful pen and ink drawings, by Mr. Train. A fine proof of an engraving, by Robinson, of Mulready's Wolf and Lamb; and also proof engravings, by Turrel, of Adcock's drawings of Steam-engines.

Mr. Turrel set up a new instrument, invented by him, and called a Perspectograph. Its object is to find any required point in the plane of the picture of a perspective view of any subject, and refer it accurately to the paper on which the drawing is to be made. This it does in the simplest manner possible, and without any embarrassment of the drawing-board or the object to be drawn. We shall give a more detailed account of this useful and simple contrivance.

Some very perfect working models of Don's patent metallic shutters were also exhibited, Mr. Don himself attending to explain the principles and advantages of his invention.

February 22nd.

An account of the recent improvements in the art of printing, (see the paper, at page 183,) was illustrated by Mr. Cowper, one of those with whom the improvements have originated.

Library.—The Kenong, a very sonorous and powerful musical instrument, from Java, was placed upon the table. It is a large metallic vessel, in the form of a contracted bowl, supported by its edge upon two strings, over a cavity in an ornamented wooden case; it owes part of the character of its sound to resonance.

The apparatus for the performance of various experiments on Resonance, or the Reciprocation of Sound, was placed upon the table, that those who had been interested in the subject of the last evening, might have an opportunity of repeating them, for their individual satisfaction.

A painting, by Sig. Luigi Gentile, being a panoramic view of the city and bay of Naples, was fixed up in the room; also one of Mr. Bennington's fine sketches from the foot of the Rialto, at Venice.

There were illustrations of botanical physiology, by Mr. Lingard; specimens of printing; a model of Charlton's press, for official papers, etchings, &c.

February 29th.

Mr. Solly exhibited a variety of specimens illustrative of the comparative anatomy of birds, and delivered a discourse upon the same subject in the Lecture Room.

[To be continued.]

On the Resonances, or Reciprocated Vibrations of Columns of Air.

[By Mr. C. WHEATSTONE.]

AN elastic body may be made to assume a vibratory state in two ways; either, immediately, by any momentary impulse, which, altering the natural positions of its particles, allows them afterwards to return by a succession of isochronous oscillations to their former state; or, secondarily, by means of an immediately sounding body, which causes it to reciprocate to the latter, when certain conditions, on which depends its susceptibility of vibrating in such a manner, are fulfilled. This reciprocation, to which, when the effect is referred to, the term *resonance* is applied, is effected by means of the undulations which are produced in the air, or in any fluid or solid medium, by the periodical pulses of the original vibrating body; these undulations being capable of putting in motion all bodies whose pulses are coincident with their own, and, consequently, with those of the primitive sounding body.—Galileo observed that a heavy pendulum might be put in motion by the least breath of the mouth, provided the blasts be often repeated, and keep time exactly with the vibrations of the pendulum; and this remark affords a correct explanation of the phenomenon.

Some of the most obvious cases of resonance are,—the vibrations of a string when another tuned in unison with it is made to vibrate; the resounding of a drinking-glass to the sound of the voice, or of a musical instrument; the reciprocated vibrations of a sounding-board, communicating immediately with a vibrating string or tuning-fork, &c. In the last mentioned instance, though the string and the fork are the original vibrating bodies, the audible sound is dependent on the resonance of the sounding-board.

As all these effects are well known*, it is unnecessary to dilate upon them here, and I may uninterruptedly proceed to the immediate object of the present paper, viz., the investigation of the laws of the resonance or phonic reciprocation of columns of air.

§ 1. If one of the branches of a vibrating tuning-fork be brought near the embouchure of a flute, the lateral apertures of which are stopped so as to render it capable of producing the same sound as the fork, then the feeble and scarcely audible sound of the fork will be augmented by the rich resonance of the column of air within the

* Biot, Traité de Physique; tom. ii, p. 183. Chladni, Traité d'Acoustique, 222, 223.

flute*. The sound will be found greatly to decrease by closing or opening another aperture; for the alteration of the length of the column of air in such case renders it no longer proper to reciprocate perfectly the sound of the fork. This experiment may be easily tried on a concert flute, with a C tuning-fork. To ensure success, it is necessary to remark, that when a flute is blown into with the mouth, the under lip partly covering the embouchure, renders the sound about a semitone flatter than the sound when the embouchure is entirely uncovered; and as the latter must be unison to that of the tuning-fork, it is necessary, in most cases, to finger the flute for B when a C tuning-fork is employed.

A similar effect may be produced by substituting, for the column of air in the flute, the alterable volume of air contained within the cavity of the mouth. I have found the sounds of tuning-forks reciprocated most intensely by placing the tongue, &c. in the position for the nasal continuous sound of *ng* (in song), and then altering the aperture of the lips until the loudest sound is obtained.

§ 2. A column of air may also reciprocate a sound originally produced by a wind instrument, as the following experiment will show. Place two concert flutes on a table, parallel to, and at a short distance from each other; on the one which is nearer, sound C sharp (all the lateral apertures being open), and draw out the tube of the second flute, so that it shall be about a semitone flatter, to make it equivalent to the flattening of the first flute by the partial closing of the embouchure by the lip; a material difference will then be distinguished in the intensity of the tone by alternately closing and opening the first hole of the more distant instrument, thereby rendering it incapable or capable of reciprocating the original sound. That this effect is occasioned solely by the transmission of the sonorous undulations, and not by any wind actually blown into the second flute, is evident from the difference being in intensity and not in pitch†.

This experiment may be varied by placing the fipple of a flageolet

* Dr. Savart has observed a similar effect by sounding a bell before a large tube inclosing an unisonant column of air. *Recherches sur les Vibrations de l'Air*. Annales de Chimie, tom. 24.

† Lord Bacon may be said to have anticipated this experiment in the following passage in his Sylva Sylvarum:—"The experiments of sympathy may perhaps be transferred from stringed instruments to others; as, if there were two bells in unison in one steeple, to try whether striking the one would move the other, more than if it were a different chord; and so in pipes, of equal bore and sound, to try whether a light straw or feather would move in one pipe, when the other is blown in unison with it." *Art.* Phonics, *Sect.* xxi. *On the Sympathy or Antipathy of Sounds with one another.*

at a short distance from the embouchure of a flute, provided, of course, that the columns of air, both in the flageolet and the flute, be capable of producing the same note.

§ 3. A cylindric or prismatic column of air, in a tube open at both ends, may vibrate not only in its entire length, but also in any number of aliquot parts, and in all cases the number of vibrations is inversely as the length of a single vibrating part. As a column of air is capable of reciprocating every sound which, according to its different modes of vibration, it is itself capable of producing; supposing $1 = C^1$ to represent the lowest sound of the tube, it will, without any change in its length, reciprocate sounds whose relations are $\overset{1}{C^1}, \overset{2}{C^2}, \overset{3}{G^2}, \overset{4}{C^3}, \overset{5}{E^3}, \overset{6}{G^3}, \overset{7}{B\flat^3}, \overset{8}{C^4}$, &c.

The harmonic subdivisions of a column of air in a tube closed at one end are different; a semi-vibrating part always exists near the closed end, but between two nodes, or a node and the open end, complete vibrating parts, as in an open tube, exist. The fundamental sound above mentioned, of an open tube, is given by a tube closed at one end, of one-half its length; the series, corresponding with the subdivisions, compared with the above, is $\overset{1}{C^1}, \overset{3}{G^2}, \overset{5}{E^3}, \overset{7}{B\flat^3}, \overset{9}{D^4}$, &c. and these sounds it can consequently reciprocate.

§ 4. Any one among several simultaneous sounds may be rendered separately audible. Thus, if two vibrating tuning-forks, differing in pitch, be held over a closed tube, furnished with a moveable piston, either sound may be made to predominate by altering the piston, so as to enable the column of air to reciprocate the sound required. The same result may be obtained by selecting two bottles (which may be tuned with water), each corresponding to the sound of a different tuning-fork; on bringing both tuning-forks to the mouth of each bottle alternately, in each case that sound only will be heard which is reciprocated by the unisonant bottle.*

* Had Sir Isaac Newton been acquainted with these, or with any similar facts, he might have illustrated his theory of the reflection of colours by an experimental, instead of a suppositious analogy with the reciprocation of sounds. As the passage in which this comparison is made, is remarkable, I will quote it. "If light be considered without respect to any hypothesis, I can as easily conceive that the several "parts of a shining body may emit rays of different colours, and other qualities, of "all which light is constituted, as that the several pipes of an organ inspired all at "once, or all the variety of sounding bodies in the world together, should produce "sounds of several tones, and propagate them through the air, confusedly inter-"mixed. And, if there were any natural bodies that would reflect sounds of one "tone, and stifle or transmit those of another, then, as the echo of a confused aggre-"gate of all tones would be that particular tone, which the echoing body is disposed

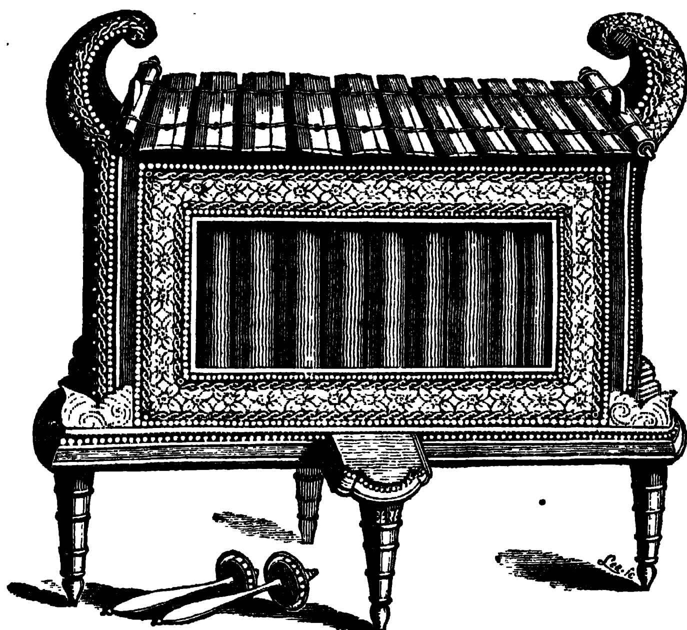
The phenomenon of a third sound, produced by the coincidences of the vibrations of two consonant sounds, is well known. From what has been premised, it is reasonable to suppose that if a column of air be caused to reciprocate this third sound, or grave harmonic as it is called, and not the two sounds which generate it, it might be heard, uncombined with the two other sounds. But on attempting this experiment, I was unable, on the following account, to succeed. The third sound is always unity when the ratio of the lowest sounds is reduced to its lowest terms; thus, with respect to a perfect fifth, 2 : 3, the third sound 1, is an octave below the lower sound, and the grave harmonic 1, of a major third, 4 : 5, is two octaves below the lower sound; we will suppose this fundamental sound, represented by unity, to be the C, corresponding with the sound of an open tube of four feet, or of a closed tube of two feet: in the first case, the column of air being capable, as explained in § 3, of vibrating in any number of aliquot parts, not only the grave harmonic = 1, but the sounds represented by 2 : 3 and 4 : 5, will also be reciprocated; and in the latter case, where the subdivisions are as the arithmetical progression 1, 3, 5, 7, 9, 11, &c., one sound of each consonance will be reciprocated, besides the grave sound. The expected result may probably still be obtained by employing columns or volumes of air, whose subdivisions are less regular.

§ 5. Among the Javanese musical instruments brought to England by the late Sir Stamford Raffles, there is one called the Génder, in which the resonances of unisonant columns of air are employed to augment, I may almost say to render audible, the sounds of vibrating metallic plates. Of these plates there are eleven; their sounds correspond with the notes of the diatonic scale, deprived of its fourth and seventh, and extend through two octaves. The mode of vibration of the plates is that with two transversal nodal lines; and they are suspended horizontally by two strings, one passed through two holes in the one nodal line, and the other through similar holes in the other nodal line of each plate. Under each plate is placed an upright bamboo, containing a column of air, of the proper length to reciprocate the lowest sound of the plate. If the aperture of the bamboo be covered with pasteboard, and its corresponding plate be struck, a number of acute sounds only (depending on the more numerous subdivisions of the plate)

" to reflect; so, since there are bodies apt to reflect rays of one colour, and stifle or " transmit those of another, I can as easily conceive that those bodies, when illuminated " by a mixture of all colours, must appear of that colour only which they reflect." *Philosophical Transactions, No.* 88.

will be heard; but on removing the pasteboard, an additional deep, rich tone is produced by the resonance of the column of air within the tube.

The instrument from which the annexed drawing was taken is at present in the museum of the Honourable East India Company; and there is another specimen in the possession of Lady Raffles.



THE GÉNDER.
Musical Instrument of Java.

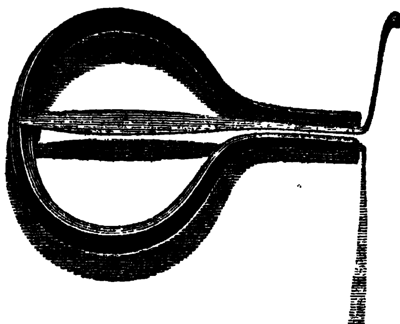
The same principle appears to have been employed, in more rude forms, in the construction of several Asiatic and African musical instruments; but I am unaware of any instrument having yet been manufactured in Europe, in which the unisonant resonances of columns of air have been made available as a means of augmenting the intensity of sounds. I shall shortly publish an account of the several modes I have myself devised, and practically employed, for advantageously applying this principle.

§ 6. In the experiments I have hitherto detailed, the reciprocated vibrations have always been isochronous with those of the

original sounding body; or, in other words, the resonance and the original sound have always been unisonant. The experiment I shall now bring forward will show that this is not universally the case, and that there are other phenomena of resonance which have never, hitherto, been investigated in their theory, or in their practical applications. I took a tube, closed at one end by a moveable piston, and placed before its open end the branch of a vibrating tuning-fork of the ordinary pitch, C; the length of the column of air was six inches; on diminishing the length of the column to three inches, the sound of the tuning-fork was no longer reciprocated, but its octave above (the sound of the column when it is directly excited) was produced. By employing a graver tuning-fork and tubes of very small diameter, and successively adjusting the lengths of the columns of air so as to be one half, one third, one fourth, one fifth, &c. of the column reciprocating the fundamental sound, the octave, twelfth, double octave, seventeenth, &c. to that sound will be produced. The relative numbers of the vibrations of these sounds, considering the vibrations of the fork as unity, are 1, 2, 3, 4, 5, &c. It therefore is evident, from experiment, that a column of air may vibrate by reciprocation, not only with another body whose vibrations are isochronous with its own, but also *when the number of its own vibrations are any multiple of those of the original sounding body.*

The converse of this law does not hold; for when the number of vibrations of a column of air are any sub-multiple of those of the original sounding body, there is no resonance. To prove this with regard to the octave, let the length of the column of air unison to the sound of a fork be doubled, and not the slightest trace of the octave below (i. e. the real sound of the column) will be perceptible: this negative experiment must be tried with a closed tube which is incapable of producing a harmonic octave; an open tube would resound unisonantly to the fork by its subdivision.

§ 7. On the law experimentally established in the preceding paragraph depends the explanation of the production of sounds by the guimbarde or Jew's harp. This simple instrument consists of an elastic steel tongue, riveted at one end to a frame of brass or iron, the form of which is represented in the annexed figure; the free extremity of the tongue is bent outwards to a right angle, so as to allow the finger easily to strike it when the instrument is placed to the mouth, and firmly supported by the pressure of the parallel extremities of the frame against the teeth.



The vibrations of the tongue itself correspond with a very low sound; but being placed before the cavity of the mouth, the form and dimensions of which are capable of various alterations by the motions of the tongue and the lips, when the number of vibrations of the contained volume of air is any multiple of the original vibrations of the tongue, a sound is produced, corresponding to the modification of the oral cavity.

Supposing the primitive sound of the tongue to be C^1, the series of sounds which it can produce by multiple reciprocation will be as follows.

Multiples of the original vibrations of the tongue.

*1...*2...3...*4...5...6...7...*8...9...10...11...12...13...14...15...*16 etc. *32.

Corresponding sounds.

C^1 C^2 G C^3 E G B♭ C^4 D E F+ G A- B♭ B C^5 etc. C^6

If the original sound be any other note, another series will arise, but the intervals of the successive sounds will always preserve the above relations. By the usual jew's harps the three first sounds of the series cannot be produced, the dimensions of the cavity of the mouth not being sufficiently large to reciprocate them.

The scale above exhibited is evidently too incomplete and too defective, to allow even the most simple melodies to be performed on a single jew's harp; but the deficiencies may be supplied by employing two or more of these instruments. Mr. Eülenstein, by availing himself of the resources afforded him by the scales of sixteen jew's harps, is able to modulate through every key, and to produce effects truly original, and of extreme beauty. Those who have heard only the rude twanging to which the performance of this instrument in ordinary hands is confined, can have no idea of the melodious sounds which, under Mr. Eülenstein's management, it is capable of producing.

§ 8. The following experiment will prove the accuracy of the

preceding explanation, and will establish the true theory of the production of sounds by the guimbarde, beyond the possibility of doubt.

I fixed a jew's harp firmly at the two points where ordinarily it rests against the teeth, allowing sufficient space between the two supports for the tongue to vibrate freely to its greatest extent; and I tuned the tongue by applying wax to its free extremity, until it sounded C, corresponding to the sound of a closed tube four feet in length. I then placed before the tongue the open end of a closed tube, containing a column of air two feet in length and one inch in diameter, and furnished with a moveable piston, by which the column could be shortened to any required length. On striking the tongue, the octave of the fundamental sound was produced, being the sound 2 of the scale in the preceding section; by shortening the column of air successively to one third, one fourth, one fifth, one sixth, one seventh, &c. &c. up to very numerous aliquot subdivisions, all the notes of the series were correctly obtained. By marking the different lengths of the piston rod for each sound of the series, I was able to produce the notes of the scale, ascending or descending regularly, or to fix any sound at pleasure.

§ 9. No other sounds can be produced by reciprocation from columns of air, but those perfectly identical with the multiples of the original vibrations of the tuning-fork, or the tongue of the jew's harp. On inquiring what takes place when the length of the column is intermediate between the lengths appropriate to reciprocate two succeeding multiples,—it will be found, that though each sound of the series is heard most audibly when the column is accurately adapted to it, yet it may also be heard, unaltered in tune, though diminished in intensity, when the column is lengthened or shortened within a certain extent, which is greater for the lower sounds of the series, and less for the higher, on account of the wider intervals between the sounds in the former case.

It may now be understood in what manner a column of air is capable of reciprocating simultaneously two or three sounds of a chord. In Mr. Eülenstein's performance, this effect is thus produced: suppose the perfect major chord of C is required; three jew's harps, incapable of producing lower sounds than the fourth of the series, are selected; and the mouth being made to correspond with the C, the other two sounds, E and G, are likewise reciprocated, though faintly, because these sounds are nearer that to which the mouth is adapted, than any other multiples of the original vibrations of the tongues are.

§ 10. When two imperfect unisons are sounded together, the interferences of their undulations give rise to periodical alternations

in the intensity of the sound; this effect is called beating, and the greater the deviation from unison is, the more rapid are the beats. From what has been above stated, the same column of air may reciprocate sounds differing in pitch; if, therefore, two vibrating tuning-forks, imperfect unisons to each other, be brought together over the embouchure of a flute, or the open end of a tube containing an appropriate column of air, the periodical recurrence of the beats will be rendered strikingly evident, slowly or rapidly succeeding each other, accordingly as the forks are more or less in tune with each other.

On the recent Improvements in the Art of Printing.

[Communicated by Mr. Cowper.]

It is a remarkable fact, that from the invention of the art of printing, to the year 1798, a period of nearly 350 years, no improvement had been introduced in this important art. In Dr. Dibdin's interesting account of printing, in the Bibliographical Decameron, may be seen representations of the early printing presses, which exactly resemble the wooden presses in use at the present day.—The immense superiority of the press over the pen induced, perhaps, a general belief that nothing more was possible, or it might be that the powers of the press were quite equal to the demand for its productions.

A new era has, however, arisen, the prompt and extensive circulation of the public journals and other periodicals requiring powers which the ordinary press could never reach.

The first important improvement of the common press was the invention of the late Lord Stanhope. This press is composed entirely of iron; the table, on which the types rest, and the platten, (or surface which gives the impression,) are made perfectly level: he has thus introduced better materials and better workmanship, to which, however, he added a beautiful combination of levers, to give motion to the screw, causing the platten to descend with decreasing rapidity, and consequently with increasing force, till it reaches the type, when a very great power is obtained. There have been, perhaps, twenty contrivances for obtaining the same effect; but as a *press*, Lord Stanhope's invention has not been surpassed. Still it is only a press, and in point of *expedition* has little superiority over its wooden rival, producing 250 impressions per hour.

Lord Stanhope was also the successful reviver of the art of ste-

reotype founding,—the process of which is as follows,—a brass frame is placed round the form of types; plaster of Paris, mixed with water to the consistence of cream, is then poured on the type, the superfluous plaster being scraped off. When the plaster is hard, the mould is lifted off by means of the brass frame, and from which it is readily detached—it is now baked in an oven, and when well dried and quite hot, it is placed in an iron box or casting-pot, which has also been heated in the oven; it is now plunged into a large pot of melted type-metal, and kept about ten minutes under the surface, in order that the weight of the metal may force it into all the finest parts of the letters,—the whole is then cooled, the mould broken and washed off, and the back of the plate turned in a lathe. This manufacture has been carried to a considerable extent; Mr. Clowes, the proprietor of one of the largest and best-conducted printing-offices in London, has on his premises between 700 and 800 tons of stereotype plates, belonging to various booksellers,—the value may be estimated at £200,000.

In connection with the Stanhope press, may be briefly noticed a little improvement for the particular purpose of printing music, after a new process, and for which I have obtained a patent.—In this new process the lines are formed of thin slips of copper driven into small blocks of wood, and the notes are formed of copper driven into a separate block. Two note blocks and two corresponding sets of lines are placed on the table of the Stanhope press; to the ordinary tympan of the press is attached another tympan, which revolves in the direction of its plane on a pin in the ordinary tympan. Two sheets of paper are placed under two friskets, hinged to the revolving tympan; an impression being now taken, one sheet will receive the notes, and the other the lines. The revolving tympan is then turned half round, when the sheets will have changed places, another impression is taken, when both sheets will be perfected.—This plan is now in operation at the printing-office of Mr. Clowes, to whom I have assigned the exclusive use of the patent.

It was in the year 1790, that Mr. W. Nicholson took out a patent for certain improvements in printing, and on reading his specification, every one must be struck with the extent of his ideas on this subject; to him belongs, beyond doubt, the honour of the first *suggestion* of printing by means of cylinders: the following are his own words, divested of legal redundancies—

"In the first place, I not only avail myself of the usual methods of making type, but I do likewise make and arrange them in a new way, viz. by rendering the tail of the letter gradually smaller,

such letter" (he erroneously says) "may be imposed on a cylindrical surface; the disposition of types, plates, and blocks upon a cylinder are parts of my invention." *See* Fig. 1.

"In the second place, I apply the ink upon the surface of the types, plates, &c. by causing the surface of a cylinder (smeared with the colouring matter) to roll over, or successively apply itself to the surface of the types, &c., or else I cause the types to apply themselves to the said cylinder,—it is absolutely necessary that the colouring matter be evenly distributed over this cylinder, and for this purpose I apply two, three, or more smaller cylinders, called distributing rollers, longitudinally against the colouring cylinder, so that they may be turned by the motion of the latter,—if this colouring matter be very thin, I apply an even blunt edge of metal or wood against the colouring cylinder.

"In the third place, I perform all my impressions by the action of a cylinder, or cylindrical surface, that is, I cause the paper to pass between two cylinders, one of which has the form of types attached to it and forming part of its surface, and the other is faced with cloth, and serves to press the paper so as to take off an impression of the colour previcusly applied—or otherwise, I cause the form of types, previously coloured, to pass in close and successive contact with the paper wrapped round a cylinder with woollen." (Fig. 1 and 2.) He also describes a method of raising the paper cylinder, to prevent the type from soiling the cloth.

These words specify the principal parts of modern printing machines, and had Mr. Nicholson paid the same attention to any one part of his invention which he fruitlessly devoted to attempting to fix types on a cylinder, or had he known how to curve stereotype plates, he would, in all probability, have been the first *maker* of a printing machine, instead of merely suggesting the principles on which they might be constructed.

The first *working* printing machine was the invention of Mr. Koenig, a native of Saxony. He submitted his plans to Mr. T. Bensley, the celebrated printer, and to Mr. R. Taylor, the scientific editor of the Philosophical Magazine. These gentlemen liberally encouraged his exertions; and in 1811 he took out a patent for improvements in the common press, which however produced no favourable result; he then turned his attention to the use of a cylinder, in order to obtain the impression, and two machines were erected for printing the Times newspaper, the reader of which was told on the 28th of November, 1814, that he held in his hand a newspaper printed by machinery, and by the power of steam.

In these machines the type was made to pass under the cylinder, on which was wrapped the sheet of paper, the paper being firmly held to the cylinder by means of tapes; the ink was placed in a cylindrical box, from which it was forced by means of a powerful screw depressing a tightly-fitted piston; thence it fell between two iron rollers; below these were placed a number of other rollers, two of which had, in addition to their rotatory motion, an end motion, i. e. a motion in the direction of their length; the whole system of rollers terminated in two which applied the ink to the types. (Fig. 4.)

In order to obtain a great number of impressions from the same form, a paper cylinder (i. e. the cylinder on which the paper is wrapped) was placed on each side the inking apparatus, the form passing under both. This machine produced 1100 impressions per hour; subsequent improvements raised them to 1800 per hour.

The next step was the invention of a machine, (also by Mr. Koenig,) for printing both sides of the sheet. It resembled two single machines placed with their cylinders towards each other, at a distance of two or three feet,—the sheet was conveyed from one paper cylinder to the other by means of tapes—the track of the sheet exactly resembled the letter S, if laid horizontally, thus, ∽: in the course of this track the sheet was turned over. At the first paper cylinder it received the impression from the first form, and at the second paper cylinder it received the impression from the second form—the machine printed 750 sheets on both sides per hour. This machine was erected for Mr. T. Bensley, and was the only one Mr. Koenig made for printing on both sides the sheet—this was in 1815. (Fig. 5.)

About this time Messrs. Donkin and Bacon were also contriving a printing machine; having, in 1813, obtained a patent for a machine in which the types were placed on a revolving prism—the ink was applied by a roller which rose and fell with the irregularities of the prism, and the sheet was wrapped on another prism, so formed as to meet the irregularities of the type prism: one of these machines was erected for the University of Cambridge, and was a beautiful specimen of ingenuity and workmanship; it was, however, too complicated, and the inking was defective, which prevented its success. Nevertheless a great point was attained; for in this machine were first introduced inking rollers covered with a composition of treacle and glue; in Koenig's machine the rollers were covered with leather, which never answered the purpose well. (Fig. 3.)

In 1815 I obtained a patent for curving stereotype plates, for the purpose of fixing them on a cylinder. Several of these machines, capable of printing 1000 sheets per hour on both sides, are at work at the present day, and twelve machines on this principle were made for the Bank of England a short time previous to the issue of gold. (Fig. 6 and 7.)

It is curious to observe that the same object seems to have occupied the attention of Nicholson, Donkin and Bacon, and myself, viz. the revolution of the form of types. Nicholson sought to do this by a new kind of type, shaped like the stones of an arch.—Donkin and Bacon sought to do this by fixing types on a revolving prism, and at last it was completely effected by curving a stereotype plate. *See* Diagram.

In these machines two paper cylinders are placed side by side, and against each of them is placed a cylinder for holding the plates; each of these four cylinders is about two feet diameter,—on the surface of the plate cylinder are placed four or five inking rollers, about three inches diameter: they are kept in their position by a frame at each end of the plate cylinder, the spindles of the rollers lying in notches in the frame, thus allowing perfect freedom of motion and requiring no adjustment.

The frame which supports the inking-rollers, called the waving-frame, is attached by hinges to the general frame of the machine; and the edge of the plate cylinder is indented, and rubs against the waving-frame, causing it to wave, or vibrate to and fro, and, consequently, to carry the inking-rollers with it, thus giving them a motion in the direction of their length, called the end motion.—These rollers distribute the ink upon the three-fourths of the surface of the plate cylinder, the other quarter being occupied by the curved stereotype plates. The ink is held in a trough; it stands parallel to the plate-cylinder, and is formed by a metal roller, revolving against the edge of a plate of iron; in its revolution, it becomes covered with a thin film of ink; this is conveyed to the plate-cylinder, by an inking roller vibrating between both. On the plate-cylinder, the ink becomes distributed, as before described, and as the plates pass under the inking rollers, they become charged with colour; as the cylinder continues to revolve, the plates come in contact with a sheet of paper in the first paper cylinder, whence it is carried, by means of tapes, to the second paper cylinder, where it receives an impression on its opposite side, from the plates on the second plate cylinder, and thus the sheet is perfected.

These machines are only applicable to stereotype plates, but they

formed the foundation of the future success of our printing-machinery, by showing the best method of furnishing, distributing, and applying the ink.

In order to apply this method to a machine capable of printing from type, it was only necessary to do the same thing in an extended flat surface, or table, which had been done on an extended cylindrical surface; accordingly, I constructed a machine for printing both sides of the sheet from type, securing, by patent, the inking apparatus, and the mode of conveying the sheet from one paper cylinder to the other by means of drums and tapes. A full description of this machine is given in J. Nicholson's "Operative Mechanic," and in the supplement to the Encyclopedia Britannica; in the latter, by some mistake, it is called "Bensley's machine." A more brief account, and also a cut of the machine, appeared in the "London Literary Gazette," the editor of which has obligingly lent the cut for illustrating this paper. *See* the Cut and Fig. 9 and 10.

My friend, Mr. A. Applegath, was a joint-proprietor with me in these patents, and he also obtained patents for several improvements. I had given the end motion to the distributing-rollers, by moving the frame to and fro in which they were placed. Mr. Applegath suggested the placing these rollers in a diagonal position across the table, thereby producing their end motion in a simpler manner. Another contrivance of Mr. Applegath's was to place half of my inking apparatus on one side the printing cylinder, and half on the other side, in order that one-half the form might be inked on one side, and one-half on the other, and so have a less distance to travel.

Another contrivance of Mr. A. was a method of applying two feeders to the same printing-cylinder; these latter inventions are more adapted to newspaper than to book printing.

We have constructed upwards of sixty machines upon our combined patents, modified in twenty-five different ways, for the various purposes of printing books, bank-notes, newspapers, &c. They have, in fact, superseded Mr. Koenig's machines, in the office of Mr. Bensley, (who was the principal proprietor of Koenig's patent,) and also in the office of the "Times," as was announced in that journal a few days since.

It may not be uninteresting to state that no less than forty wheels were removed from Mr. Koenig's machine, when Mr. Bensley requested us to apply our improvements.

Having, on the first trial of our machines, discovered the superiority of the inking-roller and table over the common balls, we

immediately applied them to the common press, and with complete success; the invention, however, was immediately infringed throughout the kingdom, and copied in France, Germany, and America; and it would have been as fruitless to have attempted to stop the infringement of the patent as it was found in the case of the Kaleidoscope. (Fig. 8.)

This invention has raised the quality of printing generally,—in almost any old book will be perceived groups of words very dark, and other groups very light; these are technically called "monks and friars," which have been "reformed altogether."

The principal object in a newspaper machine is to obtain a great number of impressions from the *same* form, or one side of the sheet, and not from *two* forms, or both sides of the sheet, as in books.

In the Times machine, which was planned by Mr. Applegath, upon our joint inventions, the form passes under four printing cylinders, which are fed with sheets of paper by four lads, and after the sheets are printed, they pass into the hands of four other lads; by this contrivance 4000 sheets per hour are printed on one side.

Machines upon our joint patents are also used for printing the—

Morning Chronicle,	Bell's Messenger,
St. James's Chronicle,	John Bull,
Morning Herald,	Standard,
Whitehall Evening Post,	Atlas,
Examiner,	Sphynx,
Sunday Times,	&c. &c.

comparative produce of the above machine is as follow

Stanhope Press	250 impressions per hour.
Koenig's Machine	1800 *i. e.* 900 on both sides
Cowper's (stereotype) . . .	2400 *i. e.* 1200 ditto.
Applegath and Cowper's (book) .	2000 *i. e.* 1000 ditto.
Ditto (newspaper) Chronicle . .	2000
Herald . .	2400
Times . .	4000—66 per minute.

A variety of machines have been invented by other persons, which have not been attended with sufficient success to make me acquainted with their merits, with the exception of Mr. Napier, who has erected several machines for newspapers.

Although the success of the inventions in which I have been engaged has rendered frequent reference to them unavoidable, I trust I have distinctly assigned to Mr. Koenig the honour of making the first working machine, and to Mr. W. Nicholson the honour of suggesting its principles, and that I have thus fairly stated the origin, the progress, and the success of the recent improvements in the art of printing.

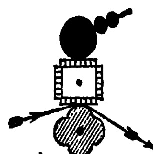
DIAGRAMS OF PRINTING MACHINES.



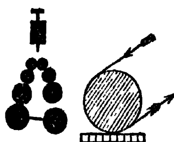
Fig. 1. Nicholson's, for arched Type.



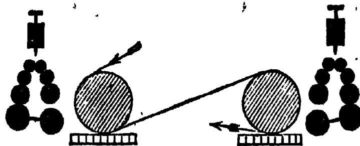
2. Nicholson's, for common Type.



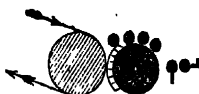
3. Donkin and Bacon's, for Type.



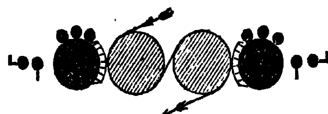
4. Koenig's single, for one side of the sheet.



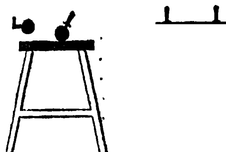
5. Koenig's double, for both sides of the sheet.



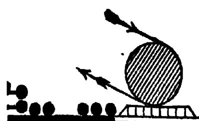
6. Cowper's single, for curved stereotype.



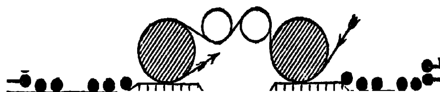
7. Cowper's double, for both sides of the sheet.



8. Cowper's Inking Table and Roller.



9. Applegath and Cowper's single.



10. Applegath and Cowper's double.

NOTE. The black parts represent the Inking Apparatus.
The diagonal lines indicate the Paper Cylinders.
The perpendicular lines, the Types or Plates.
The arrows show the track of the Sheet of Paper.

A Boy is represented laying on the paper to be printed.

A The sheet of white paper

B The cylinder which prints the first side of the paper

C Intermediate cylinders or drums, on which the paper travels to

D The cylinder which gives the final impression

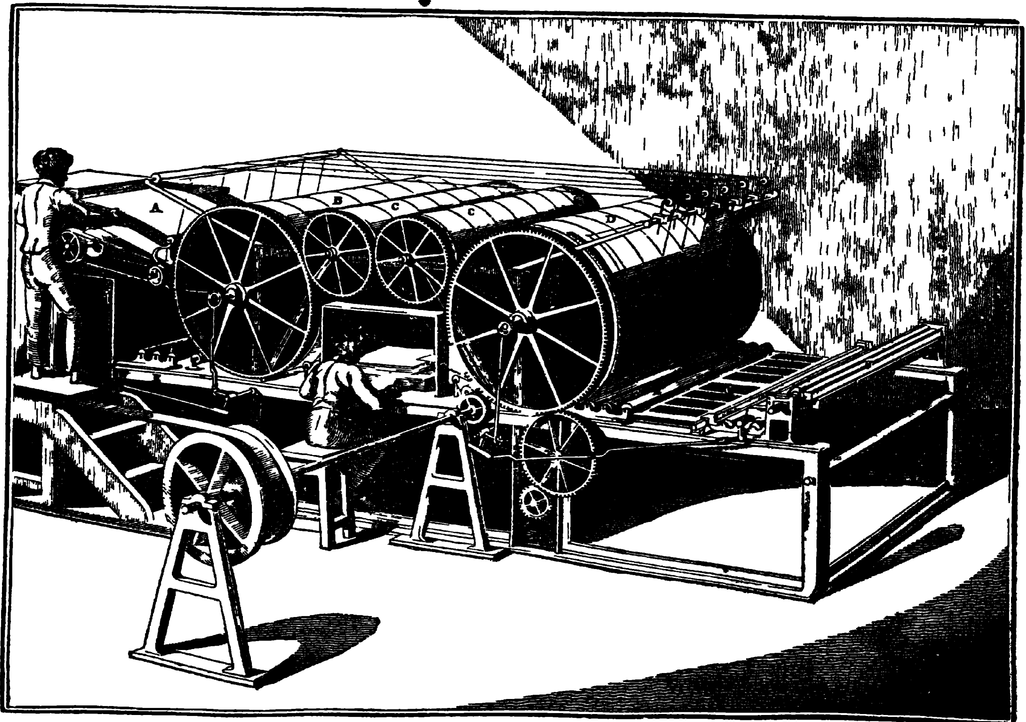
E The inking rollers under which the form (i.e. the types) is in the act of printing

F The reservoir of ink from which the inking rollers are supplied

G The form receiving its last inking before it passes under the printing cylinder

H A sheet is seen just being delivered into the hands of another boy, whose business it is to keep the sheets, as they come out, in a "heap"

The lines at the top of the machine represent the tapes which run round the cylinders and secure the sheet.



APPLEGATH AND COWPER'S PRINTING MACHINE.

Proceedings of the Horticultural Society.

December 4th.

A LONG paper was read upon the pears chiefly cultivated in the Carse of Gowrie. To residents in that part of the kingdom, it would doubtless prove highly interesting, on account of the pains and accuracy with which it had evidently been prepared; but from what we could gather from hearing it read, there is great need of reform in the fruit of the Carse of Gowrie, the very best of which is scarcely comparable to the worst of that which we Southrons reject as [illegible]. A dish of Litchi fruit, from China, [illegible] kind [illegible] fruit containing a substance very like a [illegible] placed upon the table. By the side of this was stationed a [illegible] specimen of the Ananassa bracteata, a Brazilian pine-apple, which is remarkable [illegible] as a splendid flower and a delicate fruit.

December 18th.

The most striking objects upon the table were some specimens of apples, which, it was stated, had been altered in external appearance by the influence of other kinds, the blossoms of which [illegible] near them. This is a fact, which if true, is utterly inexplicable to the philosopher; but in favour of which, it must be confessed, that there are many well attested cases which command attention to the circumstances. It has been long asserted, that [illegible] two varieties of fruit grow in the vicinity of each other and the one is influenced by the male pollen of the other, not only an ultimate effect is produced upon the seed of the variety so influenced, but an immediate and obvious change takes place in the external characters of the fruit; thus if a green apple is affected by the pollen of a yellow apple, the former will become yellow, and so on. Now, as far as we know, the fecundating aura of the pollen only affects the stigma, the stigmatic duct, and the ovulum, all exceedingly minute parts, wholly inclosed from external observation, and having as little connexion as possible with the coats of the fruit; and in the apple and all fruit, the mass of which consists of floral envelopes in a succulent state, connexion is most completely interrupted between the parts affected by the pollen, and the external coating. All that we can say is, that appearances are in favour of the assertion above referred to, and theory against it.

January 1st, 1828.

We were surprised at seeing at this meeting some fine bunches of asparagus, which had not the sickly, unnatural appearance of a

forced vegetable, but the health and vigour of a natural production of the season. Upon inquiry, we learned that they had been obtained in the garden of the Society in open beds, by practising a method employed in all the north of Europe, although but little known here. This consists in filling the alleys of common asparagus beds with hot dung, and covering the beds with the same material, protecting the whole with mats in bad weather. In this way an artificial spring is produced, which stimulates the asparagus plant into vegetation, and induces it to develope itself in precisely the same manner as when under the natural influence of an April sun. This practice is not only far more effectual than the less perfect plan of trusting to damaged roots heaped in a hot-bed; but is also more [illegible] whether the excellence or the weight of the produce is estimated.

January 15th.

A paper by Mr. Seton upon the utility of temporary copings to garden walls was read. The object of the author was to enforce the necessity of intercepting the effects of terrestrial radiation upon the blossoms of wall trees, in the clear cold nights of March, by interposing a substance between the plants and the sky; for this purpose, the common plan of adapting, in a temporary manner, boards to the front of a wall was recommended; a plan which is undoubtedly efficacious if the boards are 15 or 18 inches broad, but which is of very doubtful [illegible] if they are much narrower.

February 5th.

An extensive collection of American apples, received from New York, was exhibited. As these were undoubtedly a favourable specimen of the growth of North America, it may be useful to point out to our readers their true quality, at a time when a good deal of false value is attached to the fruit of that country, through the assertions of a certain political writer, who has found it profitable to sell the trees. In the first place, they were, without any exception, handsome fruit, particularly well grown, and neither over nor undersized. In the second place, they were, even at this late period of the apple season, quite sound, although they had sustained the disadvantage of having travelled from New York in a barrel. In the third place, they were, with two exceptions, sweetish, without acidity, or any agreeable flavour. The exceptions were the Rhode Island Greening, and the Æsopus Spitzenberg; the former of which is perhaps the most delicious apple in the world. In those who had previously studied Ameri-

can apples,this difference between appearance and reality excited no surprise, for it has long been notorious, that the character of these is that of American apples, even in their own soil, with the exception of the two above named, the Newtown pippin, the Pommegrise of Canada, and the Fall pippin. But even the latter are but indifferently adapted to our climate, the Newtown pippin, in particular, cankering, and exhibiting every mark of an irrecoverably diseased habit, unless trained upon walls with a southern aspect.

February 19th.

A paper by Mr. Lindley was read upon an Italian apple, called the Malcarle, which has been celebrated by Italian writers as the most beautiful, the most delicate, the most delicious, and the most fragrant of apples. In this opinion the writer concurred, and recommended that pains should be taken to reconcile it to our climate by giving it the assistance of a south wall. An account was also laid before the Society of the genus Calochortus, by Mr. David Douglas, who succeeded, during his travels in North-west America, in adding two fine new species to that already imperfectly described by Pursh. Of one of these which had flowered in the garden of the Society at Chiswick, a coloured drawing was handed about, from which it appeared to be a plant like a Ferraria, with brilliant purple flowers, adorned with tufts of hairs in the inside, and one of the most lovely bulbous plants with which we are acquainted. Fruit of the King date of Morocco was exhibited; this was a very sweet delicious kind of date, not much larger than a French plum, and, like that fruit, covered with a delicate bloom. It was infinitely superior to the dates of the shops, which are chiefly imported from Smyrna and Alexandria, and are to King dates what the crab-apples of our hedges are to the golden pippins of our desserts. We also observed a bottle of the fruit of Gaultheria Shallon, a North-west American plant, recently obtained alive through the activity of Mr. Douglas. It is likely to prove an acquisition of very great importance to this country, as it possesses the unusual merits of being an elegant low tree, an evergreen, a hardy plant, a good fruit, easily propagated, and promising to form capital underwood in preserves of game.

ASTRONOMICAL AND NAUTICAL COLLECTIONS.

i. *Simple Determination of the most ancient* EPOCH *of* ASTRONOMICAL CHRONOLOGY. *In a Letter to* FRANCIS BAILY, Esq., F.R.S.

MY DEAR SIR,

WHEN I addressed to you some remarks on the date of an astrological manuscript, found in Egypt, I was not aware how perfectly superfluous the chronological evidence, afforded by such fragments, is rendered by the accuracy of the original tables of Ptolemy, which were probably the basis of the computations that those fragments contain. I have since looked into these tables, as they are exhibited in the edition of Basil, which, without any suspicion of having been sophisticated by translators or commentators, is still very correctly printed; and my copy of which I read with the greater pleasure, as a gift of my friend, Professor SCHUMACHER: you have also had the goodness to furnish me with the elaborate Commentaries of the Abbé Halma, which I did not venture to consult until I had made a separate computation of the chief points that I wished to ascertain; although I afterwards obtained from them some valuable assistance in verifying my results, and in the more ready comparison of the different parts of the wonderful original with each other.

The planetary tables of Ptolemy are all carried back to the epoch of the Alexandrian noon of the first day of the first Egyptian year of the reign of Nabonassar. The mean daily motion of Saturn, as laid down in these tables, is 0° 2′ 0″ 33‴ 31⁗ 28′‴″ 51″‴″; and that of Jupiter 0° 4′ 59″ 14‴ 26⁗ 46′‴″ 31″‴″; (P. 214, 215, 217, 218.) The former of these motions is less by $\frac{1}{3700}$, the latter by $\frac{1}{12000}$ only, than those which are laid down by Bouvard in the latest of our modern tables. They therefore afford very convenient foundations for determining the exact year that was intended; and their evidence is of the more importance, as the other very slow changes, which might be employed for the same purpose, indicate, for some unknown reason, a much greater antiquity

than is consistent with collateral evidence; the changes in the position of the earth's axis, for example, both in its direction and its inclination, being considerably greater than the results of the best theories would lead us to expect in the time that has elapsed.

We may suppose, in the first instance, that the epoch of the sun's mean longitude (P. 81) is correctly laid down as 330° 45′, and his true longitude 333° 8′; the great equation, 2° 23′, being found in the table of Prosthaphaereses (P. 78), opposite to the mean anomaly 265° 15′: then, taking the sun's mean longitude at the beginning of the corresponding Gregorian year, as about 280°, the difference in the sun's longitude becomes about 50° 45′; and it will be most convenient to reduce the places of the planet to the beginning of such a year, in order to compare them with the modern tables, which are arranged according to Julian years; the difference of these years not being material for the present purpose. We thus obtain from the epochs of the tables, which are 296° 43′ and 184° 41′ (P. 213, 216), 295° for Saturn, and 180° 23′ for Jupiter; that is, in the decimal notation of Bouvard, about 328^{gr} and 200^{gr} respectively.

We now find that Saturn had returned nearly to the same mean longitude at the beginning of 1814; for which we have 327.07: and if we look back for all the years at the beginning of which the longitude is the same within a very few degrees, we shall observe recurrences more or less exact at periods of 2, of 7, and of 12 revolutions, corresponding to 59, 206, and 353 years; and we may easily make a table of all those which particularly require attention.

Year	♄ GR	Year	♄ GR	Year	♄ GR
1814	327	−657	335	− 863	335
1461		−658	322	− 864	322
1108		−687	327	− 893	327
755		−716	333	− 922	333
402		−746	325.6	− 952	326
49		−775	331	− 981	331
−304		−805	323	−1011	323
		−834	329	−1364	

Among these dates, those which afford the nearest coincidences are −893, −834, −687, and −746: and it is suffi-

ciently well known that this last is the true date, as we may at once infer from the place of Jupiter, which is 198.5^{GR} at the beginning of this year, and in −805, the nearest alternative, 208^{GR}; in −687, 189^{GR} only.

If we wish to verify the calculation, from Ptolemy's own tables of Saturn, we have, for the 2560 equinoctial years between − 746 and 1814, 2560 × 365.24222 days, making 2561 Egyptian years, and 255.1 days. Then (P. 213)

For 2268^y = 324 × 7	2°	29′	0
288	280	18	55
5 (P. 214	)61	7	0
240^d (P. 215)	8	2	14
15.1	0	30	20
	352	7	29

This is too little by $7\frac{1}{2}$°, or $\frac{1}{48}$ of a revolution, out of 87 entire ones, and the agreement would be more perfect if we supposed the time a year longer: but the motion being already slower than that of the modern tables, it is clear that such a supposition is inadmissible. In a similar manner we find, for Jupiter, the longitude in 1827, 202^{GR}, after 2574 Egyptian years and $258\frac{1}{4}$ days.

Hence, (P. 216, 218) 2430^y = 810 × 3	285°	26′	42″
144	48	54	55
240^d	19	56	58
$18\frac{1}{4}$	1	31	1
	355	49	36

The error here appears to be only 4° in 257 revolutions, which is little more than $\frac{1}{20000}$; but, in fact, it is a degree or two greater at each end, though still small enough to make the year perfectly certain.

It is therefore abundantly demonstrated, from the tables of Saturn and Jupiter only, that the Alexandrian noon of the first day of the first year of Nabonassar happened in the equinoctial year preceding the vernal equinox −746; and, according to Ptolemy's reckoning, the sun's mean longitude was 330° 45′, whence the date was M. Eq. −746^y −29.676^d: or since, according to Ptolemy's equation, the true equinox happened when the mean-longitude was 359° 23′ only, if we call the true equinox ♈︎, the date becomes ♈︎ −746^y −29.050^d;

and this date is less likely to be affected by the error of the equation than the former; but they both require correction on account of the erroneous length of the year employed in carrying back the epoch: for though Ptolemy's sidereal year is within 12 seconds of the truth, his tropical year, as well as that of Hipparchus, is about five minutes too long: since these great astronomers agree in making the Julian year too long by $\frac{3}{400}$ of a day, while the Gregorian is shorter by $\frac{3}{400}$; so that in the 600 years preceding the most accurate observations of Hipparchus, they made this difference 2 days instead of 4½, and they supposed the sun to have been 2½ days too far advanced on the day in question, and to have described a space so much shorter than the truth. This correction would give us the date ♈︎ $-746^{y} -31.55^{d}$. But the mean of Hipparchus's actual observations, reduced, with all possible care, according to the correct value of the tropical year, gives us nearly ♈︎ $-746^{y} -30.4^{d}$ for the epoch of Nabonassar.

With the assistance of Mr. Halma's table of astronomical chronology, and of the Memoirs of Professor Ideler, which he has republished, I have endeavoured to exhibit, in chronological order, the various observations which are scattered through the works of Ptolemy, and to connect them with the series of Olympiads, and with other chronological epochs. But I must defer this table to a future occasion.

Believe me, dear Sir,

Yours very sincerely,

Park Square, 8 *March*, 1828. T. Y.

ii. *Elementary View of the* UNDULATORY *Theory of Light.* *By* Mr. FRESNEL.

[Continued from the last Number.]

Of coloured Rings.

THE coloured rings, exhibited by two glasses pressed together, when one of the surfaces in contact is slightly convex, are explained in a very simple manner by the principle of interferences: they evidently result from the mutual influence of the two systems of undulations reflected at the first

and the second surface of the plate of air comprehended between these glasses. But before we enter into the detail of the explanation, it will be necessary to establish a principle with regard to the reflection of light, which will be required for this purpose.

When an agitation is propagated in a medium of uniform elasticity and density, it never returns to the same point; and while it is communicated perpetually to new strata of the medium, it leaves no traces behind, but the strata which it has passed remain in absolute rest; in the same manner as a ball of ivory, which strikes another of equal magnitude, communicates all its motion to this second ball, and remains at rest after the stroke. But the effect is not the same when the second ball is either larger or smaller than the first, for in either case the first ball continues to move after the stroke. When the second ball is greater than the first, the new velocity of the first is in a direction contrary to that of its former motion; and when smaller, the first ball continues to move in the same direction as before, so that the new velocities of the first ball, after the stroke, must be marked by contrary signs in the two cases. This comparison may assist us in understanding the consequence of the arrival of an undulation at the surface of contact of two elastic mediums of different densities: the infinitely thin stratum of the first medium, which is in contact with the second, and which may be compared to the first ball, does not remain at rest after having put the contiguous stratum of the second medium in motion, on account of the difference in their masses, and a reflection takes place: but the new velocity which belongs to the stratum of the first medium, after the stroke, and which is communicated successively to the neighbouring strata behind it, must have its sign changed accordingly as the stratum of the second medium is more or less dense than that of the first. This important proposition, which Dr. Young deduced from the considerations which have been here explained, has also been derived by Mr. Poisson from the formulas which he has demonstrated by means of a rigorous and refined analysis. When applied to the reflection of light, it enables us to infer that, accordingly as an undulation

is reflected within the denser medium or without, the velocity of the particles which constitutes the undulation is positive or negative respectively; so that all the corresponding motions must have contrary signs in the two cases.

We may now return to the phenomenon of the coloured rings, and we may suppose, to simplify our reasoning, that the reflected light, which is observed, is perpendicular to the surface, or very nearly so; and that one of the systems of undulations is thrown by the illuminating object on the first surface of a plate of air, which is also the second surface of the upper glass: and what will be said of this system is applicable to every other. At the moment when it arrives at the surface of separation of the glass and the air, it suffers a partial reflection, which diminishes, in some measure, the intensity of the light transmitted to the air, and excites within the first glass another system of undulations, of which the intensity is greatly inferior to that of the transmitted light; so that this light, being very little weakened by this first reflection, produces, when it arrives at the second surface of the plate of air, a second system of reflected waves of an intensity nearly equal to that of the waves which are derived from the first reflection: and hence their interference produces colours so bright in white light, and dark and light rings so distinct in homogeneous light. The two surfaces of the plate of air being nearly parallel, in the neighbourhood of the point of contact, where the coloured rings are formed, the two systems of waves follow the same path: but that which has been reflected at the second surface, will be found retarded, in comparison with the other, by an interval equal to twice the thickness of the plate of air which it was twice crossed. We must, besides, remark that there is another difference between them; the first having been reflected within the glass, which is the denser medium, while the second has been reflected without the second glass; whence arises, according to the principle already established, an opposition in the direction of the elementary oscillations. Thus when, from the difference of the paths described, the two systems of undulations ought to agree with each other, and so perform their motions in the same direction, we are

to conclude, on the contrary, that they are completely at variance; and, on the other hand, when the difference of the paths would indicate a complete discordance, we must infer that their oscillatory motions agree perfectly with each other. Upon these principles it is easy to determine the position of the dark and bright rings.

In the first place, the point of contact, where the thickness of the plate of air is evanescent, and produces no difference in the length of the paths of the two systems, ought to exhibit a perfect agreement in their oscillations: hence, from the opposition of the signs, the reverse takes place, and they destroy each other; so that the point of contact, when seen by reflection, exhibits a black spot. As we go further from this point, the thickness of the plate becomes greater; and at a certain distance it becomes, for example, equal to half an undulation, which would exhibit a complete discordance; but, from the change of signs, affords a perfect agreement, so as to become the most luminous part of the first bright ring. When the thickness of the plate of air is equal to half the length of an undulation, the difference of the paths described being a whole length, which answers to a perfect agreement, there will again be a perfect discordance, and the part will be the middle of a dark ring. It is easy to see, in general, from the same mode of reasoning, that the blackest points of the dark rings correspond to thicknesses of the plate of air expressed by 0, $\frac{1}{2}d$, $\frac{3}{2}d$, $2d$, $\frac{5}{2}d$, and so forth; and the most brilliant points of the bright rings to thicknesses $\frac{1}{4}d$, $\frac{3}{4}d$, $\frac{5}{4}d$, $\frac{7}{4}d$, $\frac{9}{4}d$, $\frac{11}{4}d$, and so forth; d being the length of a luminous undulation in air; or, if we take one fourth of this length for our unit, the thicknesses of the plate of air, answering to the maxima and minima of reflected light, will be represented by the following numbers:

Dark rings 0, 2, 4, 6, 8, 10. . . .
Bright rings 1, 3, 5, 7, 9, 11. . . .

It is evident that this unit, or the fourth part of a luminous undulation, is precisely the length of what Newton calls the *fits of the particles of light*: so that if we multiply by 4 the measures of them which he has given, for "the seven" principal kinds of simple rays, we obtain the corresponding

lengths of their respective undulations: and we obtain in this manner precisely the same results as when we deduce the lengths of the undulations from the measurement of the fringes produced by two mirrors, or from the diversified phenomena of diffraction. This numerical identity, which was first pointed out by Dr. YOUNG, establishes between the coloured rings and the diffraction of light, an intimate connexion, which, before his time, had escaped the notice of natural philosophers, who had been guided by the system of emanation; this connexion being a natural consequence of the theory of undulation only.

According to the experiment of Mr. ARAGO, on the displacement of the fringes produced by the interference of two luminous pencils, when one of them has passed through a thin plate of some refractive substance, we have seen that the luminous undulations are shortened within the plate, in the proportion that the sine of refraction of the substance bears to the sine of incidence out of air. This principle is universally true, and extends to all refractive substances, whatever their nature may be: for example, the length of an undulation of light in water, is to its length in air, as the sine of the angle of incidence of rays passing obliquely from [water into air], is to the sine of the angle of refraction. Consequently, if we put some water between the glasses in contact, which exhibit the coloured rings, the plate of air being replaced by a plate of water, in which the undulations of light become shorter, in the proportion which has been stated, the thicknesses of the two plates, which reflect the same rings, will be to each other in the proportion of the sines of incidence and refraction, at the passage of light from air into water. This is precisely the result obtained by Newton from observation, when he compared the diameters of the rings exhibited in both cases, and deduced from them the respective thicknesses. This remarkable relation between the phenomena of diffraction, refraction, and coloured rings, which have no connexion in the system of emanation, might have been very accurately predicted from the theory of undulation, since, in this theory, the sines of the angles of incidence and refraction must necessarily be proportional to the velocities of propa-

gation, or to the lengths of undulation of the light in the two mediums, as will shortly be seen in the demonstration of the laws of refraction.

Having explained the formation of the reflected rings by the interference of the reflections from the first and second surface of the plate of air, Dr. YOUNG has shown, that the much weaker rings, which are seen by transmission, result from the interference of the rays directly transmitted with those which have first been twice reflected within the thin plate; and that they must naturally be complementary to the reflected rings, as experiment proves that they are. It is unnecessary to enter into the detail of their explanation at present; it must only be remembered, that the great faintness of these rings, when the incidence is perpendicular, depends on the great difference of intensity of the two portions of light: [and more especially on the effect of the unaltered light, which is inseparable from them, in effacing their impression on the eye; for there is reason to think their intensity more considerable than Dr. YOUNG at first supposed. TR.]

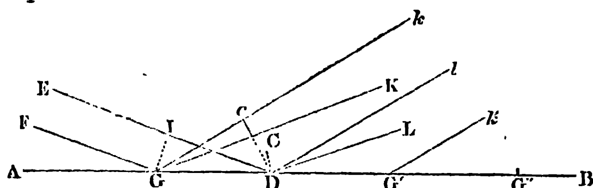
We may also pass over the phenomena of rings exhibited in light falling obliquely on the plates: observing only that the theory explains the circumstance of the augmentation of their diameters as the obliquity increases, and that the very simple formula, which is derived from it, represents the phenomena with perfect accuracy, at least until the obliquity becomes extremely great: for when the light is very much inclined to the surfaces, the results of the calculation are not so perfectly conformable to the measurements of Newton. But it is probable, that this irregularity depends upon some deviation from the ordinary laws of refraction, which are supposed in the calculation, in the case of light passing so obliquely between surfaces so near to each other.

The rings, which we have hitherto considered, are such as are produced by homogeneous light: but it is easy to infer from them what must happen in white light, by considerations similar to those which have been employed in the case of fringes, exhibited by two mirrors. This analysis of the phenomena may be found very much at length in the Optics

of Newton; who first demonstrated that the effect produced by white light depended always on the union of the different effects of the coloured rays of which it is composed.

Of Reflection and Refraction.

It has been shown, from the example of the collision of elastic bodies, in what manner a part of the undulatory motion must be reflected at the surface of contact of two mediums of different densities: while another part is transmitted, and propagated in the second medium: and for further information on this subject, the reader may consult the elegant Memoir of Mr. Poisson, on the reflection of undulations at the surface of contact of two elastic mediums of different densities, in which the general proposition is rigorously demonstrated. But although the division of the light, into reflected and transmitted rays, has been thus explained, the laws, by which their directions are governed, have not yet been demonstrated: and it will now be proper to attempt such a demonstration, from the simplest possible considerations, omitting all complicated development, which might be required for a general and strictly mathematical view of the question, in order to make the subject as clear and intelligible as possible.



Let ED and FG be two incident rays, proceeding from the same centre of undulation, which we may suppose to be at an infinite distance, so that they may be parallel to each other: let AB be the reflecting surface; let GI be drawn perpendicular to FG and ED: then GI will represent the surface of the wave at the moment when it meets the reflecting surface in G. Now, according to the principle of Huygens, we may consider each of the points agitated by the wave, as G and D, in the light of new centres of agitation acting independently, and emitting rays in an infinity of directions, and with

different intensities. It would, no doubt, be difficult to determine the law of the variation of their intensities in different directions about these points: but happily there is no occasion for such a determination; for, whatever the law might be, it is evident, that the rays passing from the two points in parallel directions would be similarly affected by it, and must possess the same intensity and the same elementary direction of oscillation: so that this principle is sufficient to enable us to judge of the direction in which the resulting undulations can be propagated. In fact, we may consider the reflected undulation at a distance from AB infinitely great, in comparison with GD, and other intervals of the same order: and supposing GK and DL to be two elementary rays that have been reflected, and that are proceeding to contribute to the formation of an elementary point of this distant undulation, and therefore parallel; and the angle KGB being equal to EDA; it is clear that the elementary motions transmitted in the lines GK and DL will agree perfectly with each other: for on account of the equality of the angles, if we draw DC perpendicular to GK, the two triangles GDC and DIG will be equal, and consequently GC will be equal to DI. But DI is the portion of the path of the incident ray ED, which it has described in its passage to the surface, after the description of EG by its collateral ray, and GC is the portion of the path of the ray reflected at G, which it has to describe beyond that which is reflected at D, in order to arrive at the point of their meeting: consequently when they meet, they will both have described the same space, and will perform their motions in perfect agreement.

But this would be no longer true, if the direction of the reflected rays were G*k* and D*l*, which are supposed also to meet in a point infinitely distant, but not to make an angle with the surface equal to EDA; for then the interval G*c*, comprehended between the point G and the end of the perpendicular D*c*, being no longer equal to ID, the paths described by the rays in order that they may arrive at the point of meeting, are no longer equal, and their oscillations at this point must be more or less discordant; now we may always take G at such a distance from D, that the difference of GC

and ID may be equal to a semiundulation; which will establish a complete discordance, at the point of concourse, between the oscillations reflected along the lines G*k* and D*l*; and as they are besides of [equal] intensities, they will mutually destroy each other; and there can consequently be no light reflected in that direction.

So true is it that the elementary ray D*l* is neutralised in this case, by that which comes from the point G, that if we suppress this last, and the other rays which are sufficiently near to co-operate with it in counteracting D*l*, we give, or rather we restore to the latter, the faculty of appearing in its place. The different elementary rays, reflected at D, are so much the more capable of diverging, as the extent of the reflective surface is the more confined on each side of this point; for the elementary ray G′*k*′ proceeding from a point G situated at the same distance from D as the point G, counteracts the oscillations of D*l* at the point of meeting, as well as the ray G*k*; and the general mode of representing these mutual destructions of the elementary rays is to consider each intermediate ray D*l* as destroyed by the half, in intensity, of the ray G*k*, together with half of G′*k*′: and then the remaining halves of these two rays by the halves of the next on each side, and so forth.

If we divide in this manner the surface of the mirror into a series of parts DG′, G′G′, and so forth, equal to GD; the elementary rays reflected at the points G, D, G′, G″, all directed to the same point of concourse at an infinite distance, and consequently parallel to each other, will differ by pairs half an undulation in their route: thus, for example, the ray G*k* will be found half an undulation in advance of the ray D*l*, and this the same distance in advance of the ray G′*k*′, and so forth: for the same reason, the ray proceeding from the middle of the line GD will be completely at variance with the ray from the middle of DG′, and a similar discordance will take place between the rays reflected from all the other corresponding points of GD and DG′: in the same manner, all the rays reflected at the different points of DG′ will be completely at variance with these which are reflected at the corresponding points of G′G″, and so forth: now the intervals GD, DG′,

G′G″, and so forth, being equal to each other, the quantity of rays which they reflect is the same: we may, therefore, consider each pencil of elementary rays reflected in this direction by any interval, DG′, as destroyed by the half, in intensity, of the rays of the preceding pencil, and by the half of the following pencil. If the surface is limited, and includes an even number of these intervals, the two remaining halves of the extreme pencils will be completely at variance when they meet, and will destroy each other at this point, so that no reflected light will be visible in this direction; but if the number of intervals is odd, the light reflected in this direction will be as little extinguished as possible, the remaining halves of the extreme pencils remaining in perfect agreement with each other. It must, however, be remarked, that in this case, the light diffracted, in the direction G*k*, will be much weaker than that which has been reflected in the direction GK, since all the rays proceeding from the surface, and uniting in the point of concourse, have described equal routes, and co-operate in their effects. All the consequences of this theory are confirmed by experiment. To give an idea of the extreme rapidity with which the light must be diminished in proportion as the direction GK deviates from that of the regular reflection, it may be added, that even when we can reckon on the surface of the mirror only five intervals such as GD, which give differences of half an undulation between their extreme rays, the intensity of the light refracted in the direction G*k* is only, according to the theory, $\frac{1}{80}$ of that of the light regularly reflected; and when the mirror is of a moderate breadth, it may easily be understood how very near the direction of G*k* must be to that of GK, in order that it may contain but five intervals such as GD, or that there may be but five semiundulations difference in the paths of the rays proceeding from the two extremities of the mirror.

It is easy to verify the consequences of this theory by throwing, in a darkened room, the rays proceeding from a luminous point on a metallic mirror, or a glass blackened at the back, of which the upper surface is covered with a coat of very opaque black, with the exception of a long and very narrow surface, comprehended between two right lines, which make

a very acute angle with each other, so that the breadth of the reflecting space continually diminishes as it approaches the angular point. If we place the mirror at a sufficient distance, and receive the reflected light on a white card, and then examine it with a magnifier, we shall remark that the pencil reflected by the part near the angle is much broader than that which comes from the remoter part, and that consequently the divergence of the reflected rays is so much the greater, as the reflecting space is narrower.

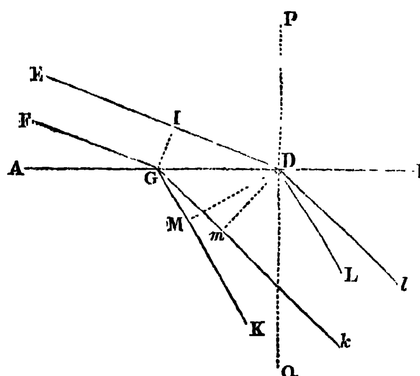
This manner of considering the nature of reflection not only explains why the rays are not subjected, in their progress, to the ordinary law of the equality of the angles of incidence and reflection, when the surface is narrow or discontinuous, but it even furnishes the means of computing their comparative intensities in their new directions. It has also the advantage of giving a clear and precise idea of that which constitutes a specular polish. We must not consider the surface of the best polished mirror as a perfect plane: it is evident, on the contrary, as Newton has already remarked, even from the mechanical process of polishing, that it must be roughened by an infinity of little projections; for the fine powder, which is employed for this purpose, can only scratch it in every direction, and it is only the extreme fineness of these scratches that renders them imperceptible. But what is the degree of fineness that they must possess, in order to produce a regular reflection? This may easily be inferred from the explanation that has been given of the ordinary law of reflection. For if the points G and G', instead of being situated exactly in the mathematical plane ADB, are a little above or below this plane, there will arise, in the path of the rays G*k* and G'*k'*, a small difference, which will lessen their total discordance with the ray D*l*; and in the particular case of a perpendicular incidence, for example, this difference would be twice the projection of the points G and G' above the plane ADB: if, therefore, this difference were the hundredth part of the breadth of a luminous undulation, the difference in the routes, which it would occasion, would be the fiftieth of an undulation: now so small an alteration from the complete discordance of the elementary rays, would

not produce any sensible light in the direction D*l*, as the calculation founded on the law of interferences demonstrates. It is therefore sufficient that the projection of the elevations, or the depth of the depressions, should be very small in proportion to the magnitude of an undulation of light, in order that the surface of the mirror should reflect no sensible light, except at an angle equal to the angle of incidence; and when the greatest inequalities do not exceed the hundredth of an undulation, for example, that is, the four or five millionth of an inch for the yellow rays, the mirror must necessarily exhibit a perfect polish; [and there is reason to suspect that, when the scratches are tolerably regular, it will have the appearance of a bright polish, even if they are incomparably larger than this. Tr.]

There is a consequence of this explanation which requires to be remarked. Since the lengths of the undulations are different for the different kinds of coloured rays which constitute white light, it may be imagined that the asperities of the surface may be of such a magnitude, as to afford a pretty regular reflection of the longest, those of the red rays, and yet to dissipate a considerable portion of the violet rays, the length of undulation of which is shorter by a third; so that in the regularly reflected image of a white object, the red and orange rays may predominate, while the green, and especially the blue and violet rays, may be in a smaller proportion, so that the tint would become reddish: and this result is confirmed by experiment. Instead of carrying the polish to a certain point only, which it might be difficult to ascertain, employ a mirror merely ground plane, and worked with fine emery, and incline it to the incident rays until you begin to distinguish a sufficiently distinct image of a white object seen by reflection; this image will appear tawny, and even of an orange red colour, like that of the setting sun, if the object is so bright as to be visible without too much inclination of the mirror. The tint of the image is the same, whatever the nature of the reflecting substance may be, whether of steel, for example, or of a greenish *crown glass*. In proportion as the obliquity of the mirror increases, the image becomes brighter and more brilliant; and when it becomes

nearly parallel to the incident rays, the reflection is as regular and almost as abundant as if it had been perfectly polished. We see, in this experiment, that the obliquity of the mirror produces the same effect as a diminution of its roughness would do: and it is easy to see the reason of this; for the roughnesses only alter the regularity of the refraction in proportion to the differences of the routes which they occasion: and it is easy to demonstrate geometrically that these differences become the smaller as the obliquity of the rays is greater.

We may now apply to the laws of refraction the same considerations which have served us for explaining the laws of reflection.



Let AB be the surface separating two mediums in which light is not propagated with the same velocity. We may still suppose the incident rays FG and ED to have proceeded from a point infinitely distant, and consequently to be parallel to each other: and we may investigate the effects pro duced by the elementary rays refracted at an infinitely great distance only, in comparison with the interval GD, or other quantities of the same order, in order to simplify the state of the problem. Drawing GI perpendicular to the incident rays, this line will show the direction of the undulation, or, in other words, the corresponding motion of the undulation will arrive simultaneously at G and I, and ID is the additional space that ED has to describe, in order to arrive at the

surface. In the same manner, if we consider two elementary refracted rays, proceeding from the points G and D, and tending to a point infinitely distant, in the directions GK and DL, and suppose DM to be perpendicular to them, GM will be the portion of the path that the ray GK must describe, beyond its companion, reckoning from the surface, in order to arrive at the point of meeting. These rays will therefore arrive at this point in equal times, if the light describes the distance GM in the same time as ID: now it is clear that this can only happen if the two spaces are proportional to the lengths of the undulations of light in the respective mediums; or, representing the lengths of the undulations by d and d', if we have GM : DI$=d' : d$. But, taking GD for the radius, GM will be the sine of the angle GDM, and ID the sine of the angle IGD: but IGD is equal to the angle of incidence IDP, and GM to the angle of refraction QDL; consequently the sine of the angle of refraction must be to that of the angle of incidence as d' is to d, in order that the two elementary refracted rays, which we are considering, may perfectly agree at their point of meeting: and this condition being equally fulfilled by all other elementary rays proceeding from the different points of the surface AB, which are reunited at the same point, all their undulations will perfectly coincide in this point, and will co-operate in their effect. It would be otherwise with the elementary rays Gk and Dl, tending also to a remote point, but in a different direction; for then Gm, being greater or smaller than GM, is not described in the same interval of time as ID, and one of these rays must necessarily be in advance of the other; now G may always be taken at such a distance from D, that this difference in their paths may be precisely equal to half the length of an undulation: so that for every elementary ray Dl, which departs from the direction DL, there is always another ray Gk directed towards the same point, which differs from it in the length of its route, by half an undulation; and whatever may be the law of variation of the intensities of the elementary rays which would originate in the agitations at G and at D, as proceeding in different directions, when separately considered, it is clear that, the circumstances being

exactly similar for the two series of vibrations which are propagated in the parallel directions, D*l* and G*k*, the intensities of these will always be the same, as well as the directions of the elementary motions ; and since these undulations differ in their progress by half an undulation, their motions will neutralise each other: and it will be impossible that any luminous oscillation should become sensible in the second medium, except in that direction which makes such an angle of refraction, that its sine shall be to the sine of the angle of incidence as *d'* is to *d*.

In the case of the divergence thus neutralised, it is not only the oscillatory motions that are destroyed, but also the condensations and dilatations which accompany them: in short, every thing being symmetrical and equal among the quantities with opposite signs that belong to the primitive motions, the same must be true of the elementary undulations which are derived from them: and this equality is sufficient to cause the mutual destruction of all the quantities with contrary signs that are concerned, whether velocities direct and retrograde, or condensations and dilatations, when any one of the positive quantities is neutralised by a corresponding negative quantity; or when there is a difference of half an undulation in the lengths of the paths described.

It may here be remarked again, as in the case of reflection, that when the surface AB is not infinite, some elementary rays are always emitted by its extremities, which are not totally destroyed, unless the intervals, like GD, answering to the difference of a semiundulation, that are contained in DL, happen to be in even number within the extent of the surface. But when this breadth is at all considerable, the diffracted light, that spreads from the edges, is much fainter than that which has been regularly refracted. For further details of this theory of refraction, the reader is referred to the Notes on the Memoir in the Collection of the *Savans Etrangers*.

When the velocity of the propagation of light remains the same in all directions, for the same medium, the relation of *d* to *d'*, and consequently that of the sines of the angles of incidence and refraction, remains constant, and the light follows the well known law of ordinary refraction. But there

are substances in which the velocity of propagation varies in the same medium, with the direction of the rays, and then those which are thus affected are no longer refracted in the same manner.

The relation which we have just found, between the sines of the angles of incidence and of refraction, agrees perfectly with the experiment of Mr. Arago, which shows that the lengths of the undulations of light in different media are to each other as the sines of incidence and of refraction at the passage of the light from one medium into the other: and this relation explains, at the same time, why the plates of air and of water, which reflect the rings of the same colours, are to each other as the sines of incidence and refraction of the light which passes from air into water.

If we generalise the considerations which have been employed for explaining the ordinary law of refraction in the particular case of a continued and extensive surface, we may determine, by means of the same formulas which represent the phenomena of diffraction, the much more complicated laws which are followed by the refracted rays, when the surface is narrow or interrupted; and we always obtain, in this manner, results which are conformable to experience; which proves both the accuracy and the generality of the principles of Huygens, and of that of interferences, on which the whole of this theory is founded.

It is impossible to conclude this concise account of refraction, without offering some theoretical views of an optical phenomenon which always accompanies it, which has been much studied, but which is, perhaps, still very little understood; that is, the division which light undergoes in passing through a prism, and to which the name of dispersion has been given, because it separates, and in some measure disperses the coloured rays, of which white light is composed, and makes them follow different routes. It results from this phenomenon, that the rays of different colours are not all equally refracted, or that the undulations of different lengths are not propagated with the same velocity in the same mediums: for it follows, from the explanation which has been given of refraction, that the relation between the sines of inci-

dence and refraction, for each kind of undulations, must always be the same with the relation of the velocities of propagation in the two mediums; so that if the different rays passed through them with the same velocities, they would be equally refracted, and there would be no dispersion. We must therefore suppose that, in refractive mediums, the undulations of different lengths are not propagated with the same velocity, or, in other terms, are not shortened in the same proportion. This consequence appears, at first sight, to be contradictory to the results of the elaborate calculations of Mr. POISSON on the propagation of sonorous undulations in elastic fluids of different densities: but it must be observed that, in this theory, the general equations are founded on the supposition, that each infinitely thin stratum of the fluid is repelled by the stratum in contact with it only, and thus that the accelerative force extends to infinitely small distances only, in comparison with the length of an undulation. This supposition is, without doubt, perfectly admissible for the undulations of sound, the shortest of which are some tenths of an inch in length: but it may possibly be inaccurate for the undulations of light, the longest of which are several thousand times shorter. It is very possible that the sphere of activity of the accelerative force, which determines the velocity of propagation of light in a refractive medium, or the mutual dependence of the particles of which it is composed, may extend to distances which are not infinitely small in comparison with the fifty thousandth of an inch: for such a supposition is not contradicted by anything that we know of their limited spheres of activity. Now it is easy to infer, from mechanical considerations, that if the sphere of activity of the accelerative forces extends actually to sensible distances, in comparison with the length of the luminous undulations, those which are the longest must be less retarded in their progress by the density of the medium, or less shortened, in proportion, than the shorter undulations, and must, consequently, be less refracted: a conclusion which agrees with the only general rule, that has hitherto been experimentally discovered, for the phenomenon of dispersion.

However this may be, the facts sufficiently show that lumi-

nous undulations of different lengths are actually transmitted with different velocities in the same refractive mediums, and in variable proportions, of which the laws are yet entirely unknown, but which seem to be very intimately related to the chemical nature of the substances. But are we to infer that there is any difference in the velocities of the different rays of light in the pure ether, which occupies the celestial space? To this question it is difficult to reply with any certainty; but the astronomical observations of Mr. Arago appear to give us a negative answer.

[To be continued.]

iii. *Principal* LUNAR OCCULTATIONS *of the Fixed Stars in the Months of May, June, July, and August,* 1828; *calculated for the Royal Observatory at Greenwich. By* THOMAS HENDERSON, Esq.

Date.	Names of Stars.	Magnitude.	Immersion and Emersion. Mean Time.	Apparent Difference of Declination.	Point of Moon's Limb.
			H. M. S.	′ ″	°
May 10	ξ Piscium	6	Imm. 15 28 38	0 49 S.	132 L.
			Em. 16 20 22	10 22 S.	92 R.
31	ρ′ Sagittarii	5	Imm. 10 56 28	6 36 N.	97 L.
			Em. 11 59 1	3 43 N.	53 R.
June 16	κ Cancri	5.6	Imm. 8 17 14	6 20 S.	76 L.
			Em. 9 17 46	2 56 N.	118 R.
July 25	ρ′ Sagittarii	5	Imm. 7 9 5	10 52 N.	81 L.
			Em. 8 0 28	8 48 N.	32 R.
Aug. 28	ο Piscium	5	Imm. Under	Horizon.	
			Em. 9 18 42	6 18 S.	74 R.

The fifth column shows the apparent difference of declination between the Star and Moon's centre at the immersion and emersion; the letters N and S denoting the Star to be north or south from the Moon. The sixth or last column shows the point of the Moon's limb where the immersion and emersion take place, reckoning from the vertex or highest point; the letters L and R signifying to the left hand or right hand of the observer.

[To be continued.]

MISCELLANEOUS INTELLIGENCE.

MEDAL FOR CHEMICAL DISCOVERIES.

JOHN FULLER, Esq. has founded a gold medal of the value of ten guineas, to be given to such members of the Royal Institution as have distinguished themselves by their labours in chemical science. He has liberally presented one of these medals to each of the following individuals, viz. Sir H. Davy, Dr. Wollaston, Mr. Hatchett, Mr. Brande, Mr. Faraday, Mr. Children, and Mr. F. Daniell ; and proposes, in future, that one of these medals shall be presented biennially. The dies are executed by Mr. Wyon, chief engraver in His Majesty's Mint ; upon the obverse is the head of Francis Lord Bacon ; and on the reverse an appropriate inscription, surrounded by wreaths of palm and laurel.

I. MECHANICAL SCIENCE.

1. *Motion produced by the contact of different Substances.*—The following fact is one published as having been described by M. B. Prevost, in 1814 :—If a very small drop of oil be placed upon a large drop of mercury, it produces a greater or smaller extension in the latter. This phenomenon, with other similar ones, is attributed to a combination of the oil with the mercury, which produces a compound, the molecular attraction of which is less strong than that of pure mercury.—*Bull. Univ.* A. viii. 341.

2. *On a Difference in the Velocity of Intense and Feeble Sounds.* —[From a correspondent.]—In some interesting remarks upon sound in the seventh number of the Edinburgh New Philosophical Journal, Mr. Meikle has called in question the truth of the received doctrine, that all sounds (whether loud or faint) move with the same velocity. Although this is true in ordinary circumstances when the sounds have not much intensity, (as when we listen to distant music,) yet it may cease to be true with regard to the intense report of a cannon. Indeed, as Mr. M. well observes, theory would lead us to suppose that the enormous quantity of heat which accompanies the explosion would increase the elasticity of the air, and the velocity of the sound, much more than in the case of sounds created by simple percussion.

It is true that in this part of the world no such difference has been observed, which may either arise from the comparison never having been carefully made, or from the difference of velocity being really inappreciable. In the frozen climates of the North, however, such a difference, if it exists, may be expected to manifest itself; for in an atmosphere perhaps a hundred degrees of Fahrenheit colder than that in which European experiments have been made, the heat at the mouth of the cannon is (relatively to the temperature of the air) very greatly increased. Such I think is the conclusion of

theory, and such is also *the fact*, as appears from the following decisive observation, for which science is indebted to the Rev. George Fisher, the astronomer in Capt. Parry's Northern Expeditions. I shall give it in his own words*. "The experiments on the 9th February, 1822, were attended with a singular circumstance, which was—the officer's word of command 'fire' was *several times* distinctly heard both by Capt. Parry and myself, about one beat of the chronometer (nearly half a second) *after* the report of the gun: from which it would appear that the velocity of sound depended, in some measure, upon its intensity. The word 'fire' was never heard during any of the other experiments. Upon this occasion the night was calm and clear, the thermometer 25° below zero, the barometer 28.84 inches, *which was lower than it had ever been observed before at Winter Island.*"

This last circumstance was probably not accidental; and if it is possible in our climate to distinguish the velocity of the sound of a bell from that of a cannon, it is at a time of diminished elasticity of the atmosphere, indicated by a low state of the barometer, that the attempt is most likely to succeed.—*H. F. T.*

3. *Distances at which Sounds are heard.*—"I recollect being, many years ago, at the west end of Dumferline, and hearing part of a sermon then delivering at a tent at Cairninghill. I did not miss a word, although the distance must be something about two miles. It was the late Dr. Black, of Dumferline, who preached, and who perhaps has seldom been surpassed for distinct speaking and a clear voice. The sound was such as I should have expected in favourable circumstances at a quarter of a mile. The wind, which was steady, but moderate, came in the direction of the sound. I was riding westward, and at length saw the Doctor finishing his sermon, otherwise I should have doubted whether he had been at such a distance. Whether the sound had run along the road as in a tube, I cannot say. I recollect little of what sort of road it is; part I think has pretty good dykes which might guide and confine the sound, aided by the wind."—*Jameson's Journal*, 1827, *p.* 184.

4. *On the effect of Wind upon Sound.*—Amongst other observations upon this point, Mr. Meikle says, "It is generally supposed that the relative velocity of sound and wind is not affected by the motion of the latter; but this opinion stands much in need of confirmation. It is clear that the effect of wind on sound is very different from merely bearing it along as a current in the ocean does a floating body. For, in this way, the intensity would undergo no sensible change, whereas we know that, in most cases, wind annihilates sound when opposed to it, and magnifies it prodigiously when moving in the same direction. The most natural inference which we can draw from this, is, that wind reflects sound in the

* Appendix to Parry's Second Voyage, page 239.

opposite direction; something in the way that the tide sends the *bore* up a river. The tremendous explosion of the Stobb's powder mills, in 1824, showed, in a very striking light, how feebly and to how short a distance sound moves against the wind, whilst it is prodigiously strengthened to leeward. A moderate breeze then blew from the south-west, and although in the opposite direction, the report was loud, and the houses sensibly shaken to the distance of thirty miles, yet very few heard it, and that feebly, three miles to windward.—*Jameson's Journal*, 1827, *p.* 105.

5. *New Material for Paper.*—According to the French papers, M. Julia Fontenelle has established a manufacture of paper from liquorice root. It is said to be very white, to require no sizing, and to be manufactured at a price much less than that made from rags.

6. *Zinc Roofs.*—Roofs covered with malleable zinc are very numerous in the Low Countries, but have one bad quality which is against them. In cases of fire, the zinc being very combustible, causes the dispersion of inflamed portions of the metal, which falling all around, occasion great danger to those who approach the building.—*Polytechnique Journal.*

7. *Method of obtaining the Figure of a Plant.*—A piece of paper is to be rubbed over with powdered dragon's blood, in the manner practised by engravers, and then the small branch or leaf of which the design is required, is to be laid upon it: by means of slight friction it soon takes up a small quantity of the powder, and being then laid upon moistened paper, an impression is to be taken in the manner practised for lithography without a machine. This process may be usefully employed for preserving certain physiognomical and characteristic features, which cannot be retained by drying the plant.—*Bull. Univ.* E. viii. 339.

8. *Assamese Method of blasting Rocks.*—The Assamese close the mouth of the hole by driving in with a mallet a stout wooden plug some inches in length, through which a touchhole is bored. Between the powder and the lower part of the plug an interval of several inches is left; the communication is perfected by means of a tin tube filled with powder, and passed through the centre of the plug.—*Monthly Mag.* v. 200.

9. *On the Effects produced on different Substances by powerful Magnets.*—In experimenting upon the action exerted by powerful magnets on different bodies, M. Becquerel found that the magnetic effects produced upon steel and soft iron by the influence of a strong magnet differed essentially from that produced on bodies in which the magnetism is weaker. In the first, whatever are the directions which they take relative to the magnet, the distribution of mag-

netism is always in the direction of the length, whilst with peroxide of iron, wood, or gum lac, it is mostly in the direction of the width, and always when only one magnetic bar is employed, whatever may be the direction taken by the substance.

These differences of effect, which establish a line of demarcation between the two sets of phenomena, are dependent upon the circumstance that the magnetism being very small in the latter bodies, the reaction of the substance upon itself may be neglected, and consequently the action of the magnet upon the substance is the most powerful agency.—*Annales de Chimie*, xxxvi. 318.

10. *On the apparent Motion of a small Body in the immediate Neighbourhood of one larger or more brilliant upon which the Eye remains fixed.*—The star ζ of the Great Bear is accompanied by one much smaller marked *g* in Flamsted's catalogue. Upon looking attentively at these two stars, I thought I saw the smaller agitated, moving irregularly near the greater, approaching to it, receding from it, and again moving to the right or left. On making other persons observe the stars, I found I was not the only one susceptible of the illusion; I have frequently repeated the experiment since, on these and other stars. I applied this effect to explain the irradiation or enlargement of the diameters of the stars, which, though it has usually been considered a physical effect, may very probably belong to the theory of sensation.

I was desirous of finding some effect analogous to that which I had observed, and to which I could have recourse, when reflecting upon the subject; and one clear morning, when in bed, I thought I saw an insect upon the window which moved in different directions and rather slowly upon the glass; but upon rising, I found that the imaginary insect was a black spot fixed upon the pane.

I then made a black spot three or four lines in diameter upon a white wall, and about a line from it another much smaller. Removing to a distance of from fifteen to eighteen feet, into a situation from which I could view them attentively, I saw the small spot agitated near the large one exactly like the star *g*, near the ζ. This experiment proves that the motion is not due to the cause to which the pheuomenon of scintillation is usually referred. I at first thought it might be occasioned by a very slight involuntary and unperceived convulsive motion in the ball of the eye; but as the whole of the ball would then move, the respective situation of the two spots should not be changed by that cause.

Perhaps this phenomenon is related immediately to our method of perception, and therefore is unsusceptible of explanation. It is, however, a fact, which has only to be well observed and clearly described, and may then be used to explain other similar effects. It is possible that it is caused by a motion of the nervous pulp of the retina itself; and indeed, the nervous or cerebral pulp of an animal has been seen to move in the manner supposed. It appears not unlikely that the whole nervous system of a living animal

moves continually in a manner more or less regular, without, how ever, any sensible change in the place of any one point.

Whatever the cause may be, it appears from the experiment that the continued action of light on a single point of the retina, occasions, in certain circumstances, a sensation similar to that which would result from the same light acting successively on several points in the immediate vicinity of each other.—B. Prévost, *Annales de Chimie,* xxxvi. 432.

II. Chemical Science.

1. *Heat evolved during Combustion.*—M. Despretz has lately read some memoirs on the heat evolved during combustion. He found that hydrogen is the body of which a given weight gives out most heat, and the metals the least. But the result is of the opposite kind if referred to equal weights of oxygen. Carbon, which, in burning, does not alter the volume of the oxygen gas it consumes, produces three-fifths of the heat evolved by the metals, iron, zinc, and tin, which reduce the oxygen to the solid state. Hence it is in the *act* of combination that we must seek for the principal cause of the developement of heat, and not in the approach of the particles. M. Despretz has also found that the quantity of heat developed by a certain quantity of a body which burns without changing the volume of the gas is the same whatever be the density of the gas.—*Le Globe, Phil. Mag.* N. S.

2. *Conducting Power for Heat of the Principal Metals, and some Earthy Substances.*—The following results have been obtained by M. Despretz, the experiments having been made with extreme care.

Gold	1000.0
Silver	973.0
Platina	981.0
Copper	898.2
Iron	374.3
Zinc	363.0
Tin	303.9
Lead	179.6
Marble	23.6
Porcelain	12.2
Fire-brick	11.4

That platina should be above copper, and even silver, induces us to insert the description of the experiment. All the bars used were square prisms. Cavities were made in them at equal distances of 10 centimetres, to receive the bulbs of small thermometers. The side of the section, except for the two last bodies in the list, was equal to 21 millimetres. The bars were covered with the same varnish, to give them an equal radiating power. The bar experimented with, was heated at one extremity by a small stove, which has the advantage of being governed readily, and of causing but little heat

in the place. The temperature of the air was ascertained by a sensible thermometer, and it was found easy to make it nearly uniform, for the whole of an experiment. Each experiment continued six hours, and it was only after two or three hours, that all the thermometers became stationary. The thermometer nearest to the source of heat soon acquires the temperature at which it is to be retained stationary, and then the heat is managed so that it shall not rise or fall by that instrument, until the experiment is finished. The following is the form of an experiment.

Bar of Copper.		Temperature of the Air 17° 03 C.	
Thermometer.	Temperature.	Excess above the temp. of air.	Quotient of the sum of two excesses, divided by the intermediate excess.
	°	°	
1st	83.44	66.36	
2nd	63.36	46.28	2.14
3rd	49.70	32.62	2.15
4th	41.40	24.32	2.11
5th	35.71	18.63	2.17
6th	33.26	16.18	

It is admitted as having been demonstrated, that the conductibility is proportional to $\frac{1}{(log. x)^2}$; x being obtained by the equation $x + \frac{1}{x} = q$; in which q is the coefficient of the sum of the excess, by the intermediate excess: and according to the results obtained with good conductors, as gold, silver, platina, copper, iron and zinc, these satisfy the experimental series which is indicated by calculation. The same is not the case with bad conductors.

Wood conducts so feebly, that a bar 21 millimetres does not become sensibly heated a few centimetres from one of its extremities so far raised in temperature as to carbonize the substance.—*Annales de Chimie*, xxxvi. 422.

3. *On the relation of Water to hot polished Surfaces.*—The tranquil state of a drop of water in a very hot silver teaspoon, or metallic capsule, with the comparative lengthened period of its evaporation, are facts well known, and are usually explained by admitting the intervention of a film of vapour which prevents the contact of the water and the metal, and so interferes with the transmission of heat. Mr. Perkins thinks he has proved that other causes are importantly active; but without referring to the opinions on this point, I have thought it may be interesting to point out another form of the experiment which I have often witnessed. A large trough of water being placed under the fire bars of a powerful furnace, the water soon becomes heated by the fall of ashes into it, and the communication of heat both by radiation and condensation. With the ashes fall numerous small globules of slag highly heated, and these will frequently remain upon the surface of the water, slightly depressing it at the place, and will float quietly about for

several seconds, as drops of water or alcohol, and other substances, do upon masses of their own fluids. During this time they retain a high temperature, cooling by comparison very slowly; but on a sudden, when at a certain point, they come in contact with the water, hiss, are quenched, forming steam, and instantly sink. When these globules have been afterwards examined, they have been found now and then hollow, but generally solid, highly polished, very round and heavy, as slags ordinarily are.—M. F.

4. *On the Tension of the Poles of a Voltaic Battery when communicated or independent.*—The well-known effect of an accumulation of electricity at the poles of the Voltaic battery, when not in connection with each other, has been experimented upon by M. Marianini. He finds that, when connected, the diminution of tension is at first rapid, and then more slowly reaches the limit which is consistent with the nature and extent of the conducting substance. Thus, with a new Voltaic apparatus, having its poles connected with an electrometer, the tension, before they were communicated, was 12°; being communicated, it became 9°.5 in 5″; 8°.5 in 10″; 8° in 30″; 7° after 1′; 6° after 2′; 5° after 5′; 4° after 10′; and rather less than 4° after 15, 20, 30, 40, and 60 minutes; but differences were produced according to the nature of the fluid used as a conducting medium.

On breaking the communication after 5 minutes, when the tension was 5°, the latter rose to 7°.5; in the space of 30″ to 8°.5; after a minute, to 10°.5 after 3′; and to 12°, or the original tension, after 5½ minutes.

An electro-voltaic apparatus, which had lost its tension in consequence of communication between its poles, had it very rapidly restored when it was connected with a second apparatus turned in the contrary direction, so that the poles of the same kind were connected together; and when this combined action was prolonged, the first apparatus withdrawn from the circuit gave evidence of a tension superior to that which it originally possessed. This increased power was observed by the condenser, and also by the magnetic needle, the deviation of the latter being sometimes thrice as great as without this peculiar effect. M. Marianini thinks that this result may lead to important improvements of the pile.—*Bull. Univ.* A. viii. p. 317.

5. *On Efflorescence, by* M. Gay Lussac.—Many salts when exposed to air effloresce, i. e. lose their water of crystallization and fall into powder; it is generally supposed that these salts, when thus effloresced, are anhydrous. Having known for a long time that this was not the case, I have made some experiments on the salts which are principally efflorescent.

Hydrated sulphate of soda exposed to air, even in damp weather, loses *all* its water of crystallization.

Phosphate of soda soon becomes opaque, but does not change its

form. After three months exposure, it contained, on July 18th, 7.4 proportions of water instead of 12, its full number. Reduced to powder and exposed in thin layers on paper to air till the 26th of the same month, it gave 6.5 proportions. Again exposed during a hot and dry period until the 31st of July, it gave only 5.65 proportions. Then being left exposed until the 21st of October, the quantity of water had increased to 7.2 proportions. Phosphate of soda, which had been calcined, acquired half a proportion of water by being exposed to air for five days.

Carbonate of soda has the same habitudes as the phosphate; it becomes opaque, and loses much water without changing its form, but it never becomes anhydrous.

It results from these observations that some salts lose all their water of crystallization by exposure to air, whilst others retain variable quantities according to the hygrometric state of the atmosphere. I do not pretend to say that definite quantities of water may not be retained, but only that, in the phosphate and carbonate of soda, the affinity which connects a certain proportion of water the seventh, for instance, with the salt, is very little different from that which combines the proportion immediately above or beneath it.—*Annales de Chimie*, xxxvi. 334.

6. *Anhydrous Crystals of Sulphate of Soda.*—If a drop of a solution of sulphate of soda be placed upon a glass plate and allowed to evaporate spontaneously, it will leave crystals which may be distinguished by their form and ultimate efflorescence, as being the salt in question. Most of the potash and soda salts may be distinguished as to their base by such an experiment. They are easily converted into sulphates by a drop or two of sulphuric acid and ignition, and then, being dissolved and tried as above, will yield crystals which may be known by their forms, and more especially by their efflorescence if of soda, and their unchangeable state if of potash. This test is, however, liable in certain circumstances to uncertainty, arising from a curious cause. If the drop of solution on the glass be allowed to evaporate at common temperatures, then the efflorescence takes place and the distinction is so far perfect; but if the glass plate with the drop upon it be placed upon a warm part of a sand bath or hot iron plate, or in any other situation of a certain temperature, considerably beneath the boiling point of the solution, the crystals which are left upon evaporation of the fluid are smaller in quantity, more similar in appearance to sulphate of potash, and finally *do not* effloresce. Upon examining the cause of this difference, I found they were *anhydrous*; consequently incapable of efflorescing, and indeed exactly of the same nature as the crystals obtained by Dr. Thompson from certain hot saturated leys*.

Hence it would appear that a mere difference in the temperature

* Quarterly Journal, xxii. 399. or Ann. Phil. N. S. xx. 401.

at which a solution of sulphate of soda is evaporated, will cause the formation of hydrated or anhydrous crystals at pleasure, and that whether the quantity of the solution be large or small. This, indeed, might have been expected from that which takes place when hydrated crystals of sulphate of soda are carefully melted; a portion dissolves, and a portion separates, the latter in an anhydrous state*. I find that, if it were desirable, crystallized anhydrous sulphate of soda might easily be prepared for the market; though, as the pure salt is now but little used, it is not likely this condensed form will be required. Whenever a soda salt is to be distinguished from one of potash, in the manner above described, this effect of temperature must be carefully guarded against.—M. F.

7. *Habitudes of Sulphuric Acid.*—M. Bellani found that the glacial sulphuric acid of Nordhausen, like common concentrated sulphuric acid, had a specific gravity of 1.843 at 50° F. and that it congealed at 53°.6. When it was exposed to air, at nearly a freezing temperature, the surface absorbed water and became covered with crystals, which, when separated and fused, gave a liquid of s. g. 1.78. On the other hand, when glacial acid was mixed with enough water to give a fluid of s. g. 1.793, it, when frozen, supplied crystals which, being melted, gave a liquid of s. g. 1.78, whilst the residual liquid had a s. g. of 1.73.

When sulphuric acid, concentrated or diluted, congeals, it undergoes a diminution of volume, almost equal in extent to the increase which takes place with water under similar circumstances. Thus, 1000 parts of fluid glacial acid become 925 parts by volume of solid acid; and 1000 parts of acid of s. g. 1.78, by congealing, become 910 parts, from which it would appear that the water in the diluted acid does not undergo the same change in solidifying, as when in the free state.—*Giornale di Fisica—Bull. Univ.* A. viii. 316.

8. *On Iodo-fluoric Acid, by* M. J. Varvinsky.—On mixing vapours of iodine and fluoric acid in a glass globe, the latter became lined with a white film, and the iodine was absorbed; when the action appeared to have ceased, water was poured into the globe and caused an immediate deposition of gelatinous silica. By filtration, a liquid was obtained, yellow from free iodine, but becoming colourless by heat; carbonate of ammonia was then added in excess, which separated the rest of the silica, and carbonic acid gas was disengaged. The filtered solution was very alkaline, but by ebullition gradually became quite acid. Being afterwards cooled, it deposited many small crystals of a fine golden yellow colour, and possessing all the properties of a strong acid. They dissolved more readily in hot than in cold water, and, with caustic potash, produced a gelatinous salt, having a very disagreeable bitter taste. These crystals are the substance which I have called iodo-fluoric

* Quarterly Journal, xix. 153.

acid. On repeating the experiments I have always obtained the same results.—*Bull. Univ.* A. viii. 360.

9. *On Testing the Presence of Ammonia in a Substance.*—Having occasion to ascertain whether the action of a salifiable base upon a body containing azote, was simply that of evolving ammonia, previously existing, or that of forming ammonia by the combination, M. Plessin was induced to search for a base which would effect the former object, but not the latter. Potash, lime, magnesia, and many other bodies do both, but the hydrated oxide of lead answered the purpose very well. It gives no indication of ammonia when put into contact with azotated substances not containing that alkali; even urea is not affected by it; but being put in contact with an ammoniacal salt, ammonia was instantly evolved, and rendered evident by the visible fumes which arose upon the approximation of a little acetic acid.—*Annales de Chimie*, xxxvi. 177.

10. *Combination of Lime with Water.*—According to M. Bellani, when lime combines with water, notwithstanding the intense chemical action which takes place and the heat evolved, there is no ultimate condensation between the elements of the hydrate. Lime was put into a matras, and then the vessel filled to the middle of the neck with water; the place of the surface of the water was then marked, after which heat was applied and the lime converted into a hydrate, no vapour being allowed to escape; when the whole was cool, the place of the surface was exactly in the same part of the neck as at first.—*Giornale de Fisica.*

11. *Examination of Copper. Precipitation of Bismuth.*—Mr. Phillips says, " some samples of copper which I examined some time since, contained a small portion of silver without any other impurity which I could detect: lately, some other samples have been put into my hands in order to determine the cause of their being complained of. The copper was dissolved in dilute nitric acid used in excess; it contained no lead; and upon the addition of muriatic acid to a very dilute solution, slight precipitation took place, which I at first imagined was occasioned, as in the former case, by the presence of silver. I happened, however, to remember a fact mentioned in conversation some years since, and which I have never met with in any chemical work—that a solution of bismuth, so dilute or so acid, that water would occasion no precipitate in it, is decomposed by the addition of common salt or muriatic acid; and this I found to be the case in the present instance; the precipitate was small in quantity, not amounting to one per cent. for the copper employed, and it differed from chloride of silver in very readily passing through filtering paper. I found it necessary, in order to determine its quantity, to supersaturate with ammonia, by which the oxide of copper was dissolved and the oxide of bismuth precipitated.—*Phil. Mag. N. S.* iii. 231.

12. *Brown Oxide of Chromium.*—This compound, first formed by Vauquelin, is considered by M. Maus as a combination of the protoxide of chrome and chromic acid; it may be formed by mixing a solution of chromate of potash with protochloride of chromium, or by boiling chromic acid with protoxide of chrome; when the substance in question is digested with acetate of lead, chromate of lead and acetate of the protoxide of chrome is formed. Potash also changes it into chromic acid and green oxide of chrome. Arsenic acid carefully added produces arseniate of chrome and chromic acid.

The brown precipitate produced by mixing chromate of potash and chloride of chromium, is decomposed by being repeatedly washed with water, especially if hot; chromic acid is removed and green oxide of chrome remains. Chromate of chromium is decomposed also in a similar manner, water removing each time more acid than oxide. Hence a great uncertainty about the composition of these substances.

If the chromate of ammonia be heated gradually to the point of decomposition, the salt is decomposed suddenly, pure deutoxide remains, which dissolves readily in concentrated acid. This oxide has been mistaken for the combination of protoxide and chromic acid If, at the moment of decomposition, the temperature be suddenly raised, a luminous appearance is produced

Chromic acid dissolves the hydrate or the carbonate of chrome readily, producing a dark brown solution, which, when evaporated, leaves a brittle resinous-looking mass; it is deliquescent and dissolves in alchohol.

A solution of the deutoxide may also be effected in chromic acid, which being analyzed, gave

Chromic acid,	72.21	or 1 atom.
Oxide,	27 79	or 2 atoms.

Peroxide of iron behaves in the same manner, and produces a similar compound with chromic acid, as the deutoxide of chromium.

The compound consists of	Peroxide of iron,	25.06
	Chromic acid,	74.94

or one atom base, two atoms of acid.—*Ann. de Chimie*, xxxvi. 216.

13. *Accension of Arsenical Cobalt Ore*—M. Boullay has had occasion to observe that, having pulverised a large quantity of arsenical cobalt ore, the mass of powder heated of itself, without any application, and ultimately took fire.

14. *Artificial Ultramarine.*—M. Guy-Lussac stated to the Academy of Sciences, at Paris, that ultramarine had been composed and manufactured for sale by M. Tunel, at a price less than half that previously paid for this pigment. M. Tunel keeps his process a secret at present, but is said to have been led to the discovery by the analysis of M. Clement.—*Le Globe.*

15. *Ancient Cannon raised from the Sea.*—A fisherman of

Calais drew up a cannon, of very ancient form, from the bottom of the sea, by means of his nets. M. de Rheims has since removed the rust from it, and on taking off the breech, was much surprised to find the piece still charged. Specimens of the powder have been taken, from which, of course, all the saltpetre has disappeared, after a submersion of three centuries. The ball was of lead, and was not oxidized to a depth greater than that of a line.—*Journal des Débats.*

16. *On the Active Principle of Hemlock* (Conium maculatum).—According to MM. Brandes and Giseke, the best method of obtaining this vegeto-alkali consists in digesting the fresh plant for several days in alcohol, filtering and evaporating the liquid, mixing the residue with water, and acting either by alumina, magnesia, or the oxide of lead; the whole is then to be evaporated to dryness, and the substance obtained acted upon by a mixture of alcohol and ether; the solution being evaporated, yields the principle now distinguished by the name of Conin *(Coma)*. This principle is said to possess decided alkaline properties; its aqueous solution forms an abundant red precipitate, with tincture of iodine. Half a grain of the substance will kill a rabbit, the symptoms being the same as those produced by strychnia.—*Bull. Univ.*, c. xii. 253.

17. *On the Identity of Althea and Asparagine.*—Mr. Bacon, some time since, announced the discovery of a new vegeto-alkali, to be called *Altheine*, or *Althea*, in the roots of the marsh-mallow. He obtained it as an acid malate of althea. An examination of the facts, however, by M. Plessin, leads him to conclude, 1st, that the fine green colour of Mr. Bacon's salt is not essential to it; 2d, that his altheine is a malate; 3d, that the acid malate of althea is not a salt, but a particular azotated substance, having the properties of asparagine; 4th, that this substance, by treatment with hydrate of lead, produces ammonia and a new acid; 5th, that magnesia produces the same change, forming, ultimately, a salt, with apparently alkaline properties; 6th, that the asparagine of marsh-mallow can assume several different forms by crystallization.

18. *On Solanic Acid*, by M. Peschier.—Solania, which is principally contained in the berries of the common nightshade *(Solanum Nigrum)*, is combined with a particular acid. This acid may be separated by means of ammonia, which precipitates the vegeto-alkali. It has a crystalline form, is soluble in water, and produces crystallizable combinations with potash and soda, the first in acicular crystals, the second in quadrilateral prisms, with a sweet taste.—Solanic acid has no action upon the salts of lime, baryta, magnesia, iron, zinc, and copper; and only a feeble action upon those of lead, silver and mercury. This acid has been found also in other

plants of the same genus, and may, therefore, be regarded as peculiar to the family.—*Bull. Univ.*, c. xii. 287.

19. *Purification of Alcohol.*—A prize was offered by the Royal Academy of Brussels to the person who should prove upon what the differences between alcohol, extracted from various substances, as fruits, grain, roots, sugar, &c. depended. This was obtained by M. Hensmans, who was led, by numerous experiments, to conclude that the alcohol was always identical, but that the difficulty, more or less great, always found in rectifying it, as well also as the difference in taste, depended upon the presence of a fatty matter, and a little acetic ether The fatty matter, when alone, may be separated by several distillations, but the acetic ether is not removed in this way. It is better, in every case, for the removal of both, to add a little caustic potash, or soda, to the alcohol, to be rectified. Carbonated alkali does not act with sufficient energy.—*Bull. Univ.*, E. viii. 289.

20. *On the Formation of Sulphuric Ether, by* MM. Dumas and Boullay, fils.—The *Annales de Chimie*, for November, contains a memoir by these two chemists, on the formation of sulphuric ether, the object being to ascertain, experimentally, how far the theory, by MM. Vauquelin and Fourcroy, relative to the mutual action of sulphuric acid and alcohol, is correct and applicable. This theory, as is well known, supposes that the first action of the acid is to separate water from the alcohol, converting it into ether, and afterwards, as the alcohol decreases in quantity, and the temperature rises, it conceives that a new action occurs, producing sulphurous acid, and oil of wine. The experiments of Saussure, Gay-Lussac, &c. all tending to confim this theory. and the objections of others to it, need not be quoted. The object of MM. Dumas and Boullay, is to analyze the different products resulting from the action of sulphuric acid and alcohol, accurately, and see what evidence they give, when compared with each other and the original bodies.

Alcohol of the s. g. of .7915, at 64°.4 F., being analyzed, gave—

Carbon	52.37
Hydrogen	13.31
Oxygen	34.61

results perfectly in accordance with those of Saussure and Gay-Lussac, which consider alcohol as consisting of one volume of carburetted hydrogen,* and one volume of the vapour of water.

Sulphuric ether, s. g. .713, at 68° F., was composed of

Carbon	65.05
Hydrogen	13.85
Oxygen	21.24

or one volume of carburetted hydrogen,* and half a volume of the vapour of water.

* Not bi-carburetted, for the elements are in single proportionals.

Sweet Oil of Wine.—"That which we examined had been separated from ether by distillation; as it requires a high temperature for ebullition, nearly the whole remained in the retort. It was then boiled until a part distilled; and, lastly, it was distilled from chloride of calcium, and a little potash. Thus prepared, its density was equal to .9174, at 51° F."

"The sweet oil of wine is merely a hydro-carbon, but the carburet differs from all those which have been as yet analyzed in the proportion of its principles."* It gave—

Carbon	88.36—88.8
Hydrogen	11.64—11.2

This indicates that the substance is composed of four volumes vapour of carbon, and three volumes of hydrogen.

Sulphorinous acid was analyzed in the form of sulphovinates of baryta, of copper, of lead, &c., and the results are given in a mixed form, being partly experimental, partly hypothetical; as for instance, because sulphate of baryta and sulphurous acid were obtained, there is set down, amongst results *obtained*, hyposulphate of baryta, &c. The conclusion, however, is, that sulphovinic acid, in a supposed dry state, is composed of

1 atom hyposulphuric acid	902.32
8 atoms carbon.	301.32
6 atoms hydrogen	37.50
1 atom of sulphovinic acid	1241.14

The theory of etherification is, then, considered as very simple; the acid and the alcohol divide into two parts, of which one produces sweet oil of wine, hyposulphuric acid and water, whilst the other portion of acid and alcohol produce diluted acid and ether; on the whole, it is concluded, that the formation of sulphovinic acid, or sweet oil of wine, although they take place simultaneously with the production of ether, have nothing to do with the evolution of the latter body.

MM. Dumas and Boullay then consider the formation and nature of the sulphovinic acid, stating the opinions of MM. Vogel and Gay-Lussac, that it is a compound of hyposulphuric acid with a vegetable matter, and also that of Mr. Hennel, that it is an acid in which half the saturating powers of the sulphuric acid present is neutralized by the hydrocarbon in combination. With the latter opinion they also class that entertained by Mr Faraday relative to the nature of sulpho-naphthalic acid. MM. Dumas and Boullay consider the question, and decide in favour of the former opinion, after which they say they have observed facts which are better explained by the latter. We think it a pity that these philosophers did not refer to Mr. Hennel's paper in the Philosophical Transactions for 1826, p. 240, where they would have gained the

* Mr. Hennel has already prepared and analyzed this substance, but with different results.—*See Phil. Transactions*, 1826, p. 247.

knowledge of a compound produced by the action of sulphuric acid and alcohol, of which they seem at present altogether ignorant, and which would have probably caused serious alterations in their views, at least with regard to sulphovinic acid. We refer to what is known in London, and sold at Apothecaries Hall, by the name of *oil of wine*, not the hydrocarbon referred to by M M. Dumas and Boullay, but a *neutral* compound of sulphuric acid with hydrocarbon, containing, with the same proportion of sulphuric acid, twice as much hydrocarbon as the sulphovinic acid. It is of this compound that Mr. Hennel speaks in the following passage, which we cannot refrain from quoting: " M. Vogel, who has particularly described some of these salts (sulphovinates), and I believe also M. Gay-Lussac, have supposed that this loss of saturating power arises from the formation of hyposulphuric acid, and that the hyposulphates and sulphovinates only differ in the latter containing some ethereal oil, which in some way acts the part of water of crystallization. It is evident that the properties of oil of wine *cannot* be thus explained; and it appears to me more probable that the power of combination *which hydro-carbon is shown to be possessed of* in oil of wine, is effective in neutralizing half the acid of the salts formed from it (sulphovinates) as before described."

21. *On Proust's Caseous Oxide and Caseic Acid.*—The results obtained by Proust,* relative to the substances produced by the fermentation of cheese, have been examined and described by M. Henri Braconnot. The substance which Proust distinguished as caseous oxide, he shows to have no claim to such a title, and proposes to call it *Aposepedine*, as being produced by putrefaction. It also appears to be produced in certain morbid diseases.

The properties which Proust has assigned to *caseic acid*, belongs, according to M. Braconnot, to various contaminating substances, none of which have any title to be considered as a particular acid. The substances present are free acetic acid; aposepedine; animal matter soluble in water and insoluble in alcohol (ozmazome); animal matter soluble in both water and alcohol; a yellow acrid fluid oil; a brown resin; acetate and muriate of potash, and traces of acetate of ammonia.

On examining the fatty matter of cheese, Braconnot found it to consist of margarate of lime with margaric and oleic acids; the butter having undergone the same kind of change during the fermentation of the cheese, as that produced when it is saponified by the action of alkalies or other bodies.—*Annales de Chimie*, xxxvi. 159.

III. Natural History.

1. *Distribution of Nerves in Muscular Fibre.*—In a memoir on Muscular Action, M M. Dumas and Prevost have communicated some

* See Quarterly Journal of Science, vii. p. 389.

very interesting microscopical observations on the distribution of the nerves in the muscular fibres, and on the forms which these latter assume during their contractions. They placed a thin piece of muscle retaining its nerves under the microscope, and made it contract by means of galvanism. The fibres contracted by bending in a zigzag manner, and the last nervous filaments were seen to proceed parallel to each other, from the branch giving origin to them, to be inserted precisely at the points where the fibres form their angles.—*Jameson's Journal*, 1827, p. 200.

2. *Disease of Silk Worms and its cure.*—In the southern parts of France, where silk worms are raised, it is very common to observe the insects attacked by a disease called the jaundice, in consequence of the colour acquired by them. Very careful examination is continually made for the discovery of such worms as may be attacked by it, that they may be removed, lest the disease, being contagious, should spread to the others.

The Abbé Eysseric of Carpentras had recourse to a remedy in these cases, which, though apparently dangerous, had been warranted by the success of twenty years. He used to powder his worms over with quick lime by means of a silk sieve; he then gave them mulberry leaves moistened with a few drops of wine, and the insects instantly set about devouring the leaves with an eagerness which they did not usually show. Not one of the hurdles upon which he raised his worms appeared infected with the jaundice. It was at first supposed, that the cocoons of silk were injured by this process; this, however, is not the case, and his method of practice is now adopted generally in the department of Vaucluse.—*Bull. Univ.* D. viii. 360.

3. *Temperature below the Earth's Surface.*—Mr. Fox, in an additional paper relative to the temperature of the interior of the earth, as indicated by the temperature of the waters issuing from the bottoms of mines, states, upon the authority of a friend, in the firm of Barclay, Perkins, and Co., that the water in a well in their premises, in Southwark, 140 feet deep, is invariably at the temperature of 54°, which is 4°.5 above the mean climate of London, according to Howard, who calls it 49°.5.

From experiments made upon the mean temperature for a whole year, at the following places, in the mining districts, namely,—

Huel Gorland	48.99
Dolcoath	49.94
Falmouth	50.67
Mean	49.86

it would appear that the mean temperature of the earth's surface in our climate is under 51°, and even less than 50° in a considerable portion of these districts. This is from ten to nearly thirty degrees

less than the temperature of the water drawn from the mines.—*Trans. Geolog. Society, Cornwall.*

4. *Extraordinary Instances of Fall of Rain.*—May 20, 1827, six inches of rain fell at Geneva in the short space of three hours.

From September 23 to 27, 1827, there fell at Montpellier, fifteen inches eight lines of rain. In forty-eight hours, from the 24th to the 26th of that month, eleven inches ten lines of rain fell at M. Berard's manufactory, near Montpellier.

The fall of rain at Joyeuse (department de l'Ardêche) was, according to the registers of M. Tardy de la Brossy, most extraordinary. The maximum of rain collected in any one day, for twenty-three years, was on the 9th of August, 1807, as much as nine inches three lines. But on the 9th of October, 1827, there fell *twenty-nine inches three lines of rain*, in the space of twenty-two hours. Eleven days of that month, according to the same registers, gave thirty-six inches of water, or about double the quantity which fell at Paris during the whole year.

During the dreadful fall of rain on the 9th, the barometer was nearly stationary, and only two or three lines beneath its mean height. Claps of thunder succeeded each other without intermission.—*Annales de Chimie*, xxxvi. 414.

5. *Rain at Bombay.*—In a letter from Mr. Scott, jun. of Bombay, he says that, during the first twelve days of the rainy season, thirty-two inches of rain fell, and that then all the roads became like rivers. In England, the average fall for the whole year is thirty-two inches.—*Jameson's Journal.*

The average fall at Bombay is not given.

6. *Meteorological Prognostication observed in the Shetland Isles.*—Mr. Scott, professor at the Sandhurst college, states that he has witnessed the following effect. It has been the custom to place drinking glasses in an inverted position upon a shelf in a cupboard on the ground floor of Belmont House. These glasses frequently produce spontaneous sounds similar to those which could be occasioned either by tapping them lightly with a penknife, or by raising them a little, and letting them fall upon the shelf. These sounds always indicated wind, and whenever they occurred, the boats and vessels were immediately placed in security. No indication was given of the quarter from which the wind would come, but the strength of the sound was always proportionate to that of the tempest. The latter came sooner or later, but generally several hours after the sounds.

Mr. Scott states, that there was no sensible motion either in the glasses, or their support, at the time when the sound was strongest, and he thinks that the cause of the phenomenon may be electricity.—*Annales de Chimie*, xxxvi. 416.

7. *Fall of Aërolites.*—On the 26th Sept. (Oct. 8th) last, a shower of aërolites fell near Belostok, between nine and ten o'clock in the morning. The inhabitants were alarmed by an extraordinary noise which proceeded from a large black cloud that hung over their heads, and which continued for three (some say six) minutes, resembling a running fire of musketry. The noise, which was heard by several persons at the distance of more than fourteen wersts, was succeeded immediately by a shower of stones, of which only four were picked up; the largest weighed four pounds, the smallest three quarters.—*St. Petersburgh Gazette.*

8. *Cold and Warm Localities in the Valley of Ouse, in Norway.*—In the parish of Uldvig, in Norway, is a small valley bounded by steep mountains, and opening into the bay of Ouse-Fjorden. A cavity, which occurs in the rocks of this valley, is always at so low a temperature, that the snow and ice of a preceding winter do not melt away in it. The inhabitants of the Ouse village use this natural cavern for the preservation of their food.

Fifty steps further is another cavity, or rather a space between the rocks which retains a mild temperature in all seasons, being from 10° to 20° higher than the external temperature during the winter season. The rocks about the neighbourhood are mica slate, quartz, and gneiss. It is supposed that there are some minerals beneath which evolve heat upon the access of water, and it has been observed that snow always melts rapidly upon the soil of the place.—*Bull. Univ.* B. xii. 366.

9. *Inflammable Gas from Salt Works.*—Whilst boring in search of salt, at Rocky Hill, Ohio, about 1½ mile from Lake Erie, the auger fell at the depth of 197 feet, brine spouted out for several hours, and then a large quantity of inflammable air issued, which took fire and burnt the combustible things in the neighbourhood.—*Trans. Soc. New York.*

A constant current of inflammable gas has also issued for sixty years past from one of the pits in the salt mine of Gottesgabe, at Rheine, in the county of Tecklenbourg, and sometimes gas issues from other parts of the works. It is said that M. Rœders, the inspector, collects this gas in old pits, conducts it to his house by tubes, and burns it both for the purpose of giving light and also heat. Its flame is said to be brilliant; its specific gravity 0.66. It contains only traces of carbonic acid and of sulphuretted hydrogen.—*Brewster's Journal.*

10. *Potash in Mineral Waters.*—The analysis of the warm mineral water of Bourbon-Lancy, in the department of Saône et Loire, made by M. Puvis, has shown the presence of potash in it as muriate of potash. The quantity is but small, the muriate being but one 13 5 part of the extraneous matter present. The other substances were muriate of soda, sulphate of soda, sulphate of lime, car-

bonate of lime, silica, and traces of carbonate of magnesia, and oxide of iron.—*Annales de Chimie*, xxxvi. p. 289.

Our readers will see an account of the presence of potash in a mineral water in the xviiith vol. of the Quarterly Journal, p. 178, that water being from Cheltenham.

11. *Floating Volcanic Products.*—From the *Journal du Havre*, July 20, 1827;—Capt. le Sauvage, of the Bonne Emma, came in yesterday from Senegal, and says, that on the 29th June, 1827, being about 20 leagues to the east of the Azores, he traversed a space three leagues in width, covered with volcanic stones, sugar canes, straw, and pieces of wood. He supposed these debris had been caused by the eruption of a volcano.—*Annales de Chimie*, xxxvi. 418.

12. *Large Masses of Native Platina.*—One by Humboldt, from Peru, now in the Berlin Museum; weight 1083 grains. Another from America, in 1822, weighing 11610 grains, now in the Madrid Museum. A third, a few months since from the Uralian mountains, deposited in the Museum at St. Petersburgh, weighing $10\frac{84}{95}$ Russian pounds, or above eighty-one thousand grains.—*Jameson's Journal.*

13. *Platina Sand of Russia.*—Professor Breithaupt, who has examined the Russian metalliferous sand washed out of the sand of Nijnotaguilsk, in the government of Perme, in Siberia, describes it as being of two kinds. The purest and most quartzose affords principally fine wash gold, the other is ferriferous, and is that which contains the platina. The latter was found, upon mere inspection, to consist of very different matters, and the following substances were in this way separated, i. platina of two kinds, the one like that from America, the other of a dark grayish colour, magnetic, and containing a considerable proportion of iron; ii. gold; iii. the native alloy of iridium and osmium; iv. flat silvery white grains of palladium; v. iserine or magnetic iron sand.

The grains of this sand were very sharp-edged, and even bristled with points in some places, from which it would appear that they could not have rolled far, and must have been found at no great distance from their origin.

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR 1827.

Months	Mean of Thermometer			Thermometer		Mean of Barometer			Barometer		Prevailing Winds, and No of Days of each				Wind variable	Snow or Rain	Fall of Rain
	8	2	10	Max	Min	8	2	10	Max	Min	N	E	S	W			
January	34 16	37 90	34 61	52	7	29 48	29 44	29 47	29 95	28 75	10	3	14	4	0	13	2.74
February	32 28	37 92	31 89	48	20	70	71	71	30 25	28 90	12	10	4	2	0	4	.71
March	40 96	47 52	41 80	57	27	24	24	26	29 80	28 30	6	0	10	13	2	15	3 74
April	47 33	55 10	46 10	78	31	.57	56	57	29 95	29 10	5	2	16	4	3	14	.77
May	54 03	62 06	51 90	75	35	38	37	37	29 75	28 95	5	2	20	3	1	16	1.29
June . .	57 80	63 83	55 46	73	40	.54	53	53	29 95	29 05	5	3	10	10	2	12	1 67
July	61 61	68 03	60 87	80	50	.69	.65	65	30 05	29 25	2	3	15	10	1	11	1 77
August	57 93	63 03	56 04	74	45	.62	62	63	30 00	28 95	11	3	7	7	3	14	3 63
September	56 00	60 33	55 60	69	46	59	58	.55	30 05	29 05	5	3	16	2	4	17	2 57
October	51 58	57 67	52 41	68	33	35	35	38	30 00	28 70	3	4	20	3	1	16	4.40
November	43 80	47 53	45 50	59	20	58	55	56	29 95	29 05	2	3	18	6	1	11	3.37
December	43 38	46 87	45 00	55	17	33	33	33	30 25	28 50	2	0	22	7	0	21	3.51
Average of the Year	48 40	53 98	48 09	80	7	29 50	29 49	29 50	30 25	28 50	68	36	172	71	18	164	30 17

The hottest day was July 29 Thermometer in Shade 80 The coldest day Jan 3 Thermometer 7. The fall of rain exceeds that of 1826 by 10 55 inches, but is still below the annual average which amounts, upon a calculation of ten years, to about 33 inches The mean annual height of the Barometer is less than that of 1826 by 40, and the mean annual temperature at 2 P M exceeds that of 1826, merely by 08 The mean of 1826 being 53 06 that of 1827 being 53 98.

METEOROLOGICAL DIARY for the Months of December, 1827, and January and February, 1828, kept at Earl Spencer's Seat at Althorp, in Northamptonshire.

The Thermometer hangs in a North-eastern Aspect, about five feet from the ground, and a foot from the wall.

For DECEMBER, 1827.

		Thermometer.		Barometer.		Wind.	
		Lowest.	Highest	Morn.	Eve.	Morn.	Eve.
Saturday ..	1	43	50	28.90	28.80	W	W
Sunday	2	42	45	28.98	29.10	NW	N
Monday....	3	42	49	29.52	29.60	N	WSW
Tuesday ...	4	40	55	29.57	29.60	WSW	W
Wednesday.	5	49	55	29.70	29.70	W	W
Thursday ..	6	43	45	29.60	29.80	WbN	NW
Friday	7	33	48	30.08	29.77	WbN	SW
Saturday...	8	33	45	29.60	29.75	NW	W
Sunday	9	28	50	29.75	29.57	W	S
Monday....	10	38	54	29.41	29.30	S	SW
Tuesday ..	11	41	50	29.27	29.27	SW	SW
Wednesday.	12	38	43	29.27	29.27	SbW	SW
Thursday ..	13	36	45	29.27	29.20	W	W
Friday.....	14	34	51	29.27	29.24	S	W
Saturday...	15	38	52	29.50	29.44	WSW	SSW
Sunday	16	40	45	29.50	29.67	W	WSW
Monday....	17	33	44	29.95	29.86	SW	SW
Tuesday ...	18	43	50	29.63	29.50	W	SSW
Wednesday.	19	48	53	29.38	29.36	SW	SW
Thursday ..	20	42	48½	29.28	29.39	WSW	S
Friday	21	35	43	29.40	29.37	SW	SE
Saturday...	22	42	51	29.22	29.34	WSW	W
Sunday	23	35	47	29.27	29.80	NW	SbW
Monday ...	24	37	56	29.65	29.63	SSW	W
Tuesday ...	25	34	46	30.16	30.20	WbS	SW
Wednesday.	26	43	51	30.28	30.28	SW	SbW
Thursday ..	27	43	52	30.27	30.33	W	NNW
Friday.....	28	29	40	30.57	30.48	NNW	N
Saturday...	29	25	34	30.40	30.32	W	W
Sunday	30	19½	40	30.26	30.10	ESE	ESE
Monday ...	31	32	46	29.78	29.51	SE	SSW

For JANUARY, 1828.

		Thermometer.		Barometer.		Wind.	
		Lowest.	Highest	Morn.	Eve.	Morn.	Eve.
Tuesday ...	1	41	46	29.48	29.51	S	NW
Wednesday.	2	32	47	29.70	29.39	W	S
Thursday ..	3	33	50	29.30	29.52	W	W
Friday	4	31	41	29.65	29.50	SW	WbS
Saturday...	5	32	39	29.46	29.48	W	NE
Sunday	6	33	38	29.63	29.78	NE	E
Monday ...	7	33	36	29.81	29.80	E	E
Tuesday ...	8	33	37	29.74	29.87	E	E
Wednesday.	9	31	33	29.90	29.71	E	NE
Thursday ..	10	26	31	29.63	29.57	NE	E
Friday.....	11	24½	31	29.48	29.44	E	SE
Saturday...	12	31	46½	29.63	29.54	W	SE
Sunday	13	35	44½	28.98	29.30	SW	WbS
Monday.. .	14	38	40	29.47	29.19	NNW	ENE
Tuesday ...	15	33	36	29.60	29.67	NE	E
Wednesday.	16	30	37	29.66	29.70	EbS	E
Thursday ..	17	35	48	29.74	29.76	E	SE
Friday	18	42	56	29.90	29.96	SW	S
Saturday...	19	44	56	30.00	30.09	SW	SW
Sunday	20	46	53	30.01	30.09	SW	SW
Monday ...	21	39	51	30.00	30.00	SW	SW
Tuesday ...	22	40	51	29.90	29.98	SW	SW
Wednesday.	23	40	50	30.00	30.10	W	W
Thursday ..	24	39	53	30.10	30.12	SW	SW
Friday	25	42	55	30.00	29.87	SW	W
Saturday...	26	36	48	29.36	30.10	W	W
Sunday	27	37	50	30.13	30.20	W	W
Monday....	28	28	41	30.20	30.20	W	SW
Tuesday ...	29	28	47	30.07	30.00	SW	SW
Wednesday.	30	33	48	29.90	29.88	SW	S
Thursday ..	31	37	51	29.80	29.78	SE	SW

For FEBRUARY, 1828.

		Thermometer.		Barometer.		Wind.	
		Lowest.	Highest	Morn.	Eve.	Morn.	Eve.
Friday	1	45	50	29.72	29.80	SW	SW
Saturday...	2	37	48	29.90	29.90	W	SW
Sunday	3	32	45	30.24	30.27	W	SSW
Monday....	4	35	51	30.10	30.08	W	W
Tuesday ...	5	45	54	30.00	29.97	W	SW
Wednesday.	6	45	54	29.88	29.86	SW	W
Thursday ..	7	49	50	29.80	29.76	W	SW
Friday.....	8	32	45	29.76	29.67	W	N
Saturday...	9	34	41	29.58	29.58	NE	N
Sunday ...	10	31½	35	29.67	29.67	ENE	E
Monday....	11	28	36	29.38	29.51	E	ENE
Tuesday ...	12	28	35	29.80	29.88	NW	N
Wednesday.	13	28½	37	29.92	29.92	NE	SE
Thursday ..	14	29	36½	29.61	29.35	SE	SbW
Friday.....	15	25½	39	29.48	29.57	W	W
Saturday...	16	22	42	29.66	29.67	W	SE
Sunday	17	24	39	29.60	29.47	SW	SE
Monday....	18	27	41	29.30	29.20	SE	SE
Tuesday ...	19	33	45	29.11	29.19	W	SbE
Wednesday.	20	35	49	29.19	29.06	SbE	SE
Thursday ..	21	37	45	28.96	28.89	EbS	SE
Friday	22	36	47	28.88	28.90	E	E
Saturday...	23	36	42	29.19	29.30	NE	NW
Sunday	24	33	47	29.56	29.58	W	SW
Monday....	25	38	54	29.58	29.60	SW	SW
Tuesday ...	26	40	57	29.78	29.80	S	SSW
Wednesday.	27	46	58	29.85	29.95	S	WbS
Thursday ..	28	40	51	30.10	30.12	NW	NW
Friday.....	29	39½	53	30.08	30.10	NW	NE

THE

QUARTERLY JOURNAL

OF

SCIENCE, LITERATURE, AND ART.

Memoir on a New Calculation of the Latitudes of Montjouy and Barcelona; being a Supplement to the Base du Système Métrique.—By J. N. Nicollet, of the Royal Observatory, Paris.

(Translated from the original MSS., communicated by the Author.)

In the great work of the measurement of an Arc of the Meridian between the parallels of Dunkirk and Barcelona, the southern part of the operations, viz. that between Rhodez and Montjouy, was allotted to M. Méchain. Quitting Paris for Spain in June, 1792, and assisted by M. Tranchot and two Spanish commissioners, M. Méchain executed, with very remarkable activity and success, the observations of every kind committed to his charge. Before eight months were expired he had covered the space comprised between Barcelona and the Pyrenees with triangles; had completed the observations of latitude and azimuth at Montjouy; as well as many other observations incidentally connected with the operations, such as observations of comets, solstices, occultations, and eclipses of every kind; and had ascertained the possibility of prolonging the arc to the Balearic Islands.

It remained to connect the chain of triangles in Spain with the nearest stations in France, and to extend the triangulation to Rhodez. M. Méchain had flattered himself with the prospect of accomplishing this in less than a year; but the troubles of the French revolution, the war which broke out with Spain, and the terrible accident which happened to himself,*

* He was struck by the handle of a machine employed in raising water at Barcelona, which broke his shoulder blade and several ribs.

destroyed these hopes. The confinement occasioned by his accident prevented his availing himself of the season proper for such operations, and which he would so usefully have employed. When able to resume his labours, the Spanish Government refused him passports, and detained him prisoner, with liberty to choose his place of abode. He chose Barcelona, to be as near as possible to Montjouy, which he was forbidden to enter, and where the preceding year he had observed the latitude of the centre of the tower of the fort. That he might make his residence useful to astronomy, whilst prevented from pursuing the special object of his mission, he applied himself to determine the obliquity of the ecliptic; and thus, necessarily, the latitude of his new station. Reflecting afterwards that this latitude might be rendered useful as a verification of that of Montjouy, he connected the two stations geodesically. In following carefully the record of his operations, we cannot fail to recognize his studious endeavour to render the results obtained at the two stations dependent on the same elements, and therefore strictly comparable. He employed, for example, at both stations, the same instruments, the same modes of adjustment and observation, (with very few exceptions) the same stars, and the same elements to reduce and calculate his results. Throughout we observe that exceeding care, those minute precautions, and unvarying habits of precision, which are so universally allowed to this skilful observer. The series in each star proceed regularly, and all the stars are in accord, with the exception of one, although several are in positions exceedingly unfavourable to exactness of observation. His zeal, however, and his efforts, led to a most unexpected conclusion. The comparison of the latitudes of Montjouy and Barcelona, given in the second volume of the Measurement of the Arc of the Meridian, presents a difference of 3″.25 greater than is due to the well ascertained distance between the places of observation. It has been attempted to explain this difference on two suppositions; first, a want of verticality in the plane of the instrument; and second, a deviation of the plumb-line at Barcelona, caused by the attraction of Montjouy. But the magnitude of the deflection of the plane from the vertical, necessary on the first supposition, and a careful examination of the locality not being found to correspond to the

second supposition, have prevented the adoption of either of these methods of explanation.

Besides the principal difficulty which has thus remained so long unexplained, there is a second, which though less prominent, has not less contributed to throw a doubt over the determination of this important point of the arc of the meridian. It regards the latitudes obtained by the star ζ Ursa Majoris, which both at Montjouy and Barcelona are 4″ less than those obtained by the other stars. This second anomaly has given rise to as much discussion as the first; its principal cause has indeed been shown, but there is a second cause which, I believe, has also contributed to produce the anomaly, which has not yet been pointed out: thus its solution has remained incomplete to the present day; as the difference which we have stated to exist between the determinations at Montjouy and Barcelona has also remained unexplained and unaccounted for; each person, as influenced by disposition, or by the means of information which he has possessed, attributing the discrepancies to "errors of observation," or tc "anomalies from natural causes."

A series of astronomical observations, in which I have been engaged for some years past, has led me to examine this subject, so long a mystery to men of science. This series includes certain double stars, amongst which ζ Ursæ Majoris is comprised. Knowing it to be a double star, and recollecting the discussions to which it had given rise, I thought it possible that M. Méchain might not have been aware of this fact, and I accordingly sought what would have been the effect in regard to his observations; availing myself of the same occasion to recalculate the whole of the latitudes of Montjouy and Barcelona, with the more exact information which we now possess of the places of the respective stars, and with the additional knowledge, in other respects, which astronomical science has acquired since the time of M. Méchain.

ζ Ursæ Majoris is composed of two stars, one of the 3rd, the other of the [illegible]th magnitude, which are 14″ apart: the lesser is to the south, and differs from the other in declination from 11″ to 12″. MM. Méchain and Delambre appear to have been unaware of this fact; at least I cannot trace any notice of it, either in their publication respecting the arc of the meridian, or in their original manuscripts deposited in the

archives of the observatory; nor is there any allusion to it in any of the numerous writings in which M. Delambre returned to the discussion of these anomalies. It requires a telescope of considerable power to distinguish the stars apart; those of the ordinary repeating circles, which I have examined, do not separate them. We cannot now examine the particular circle employed by Méchain for this star, as he parted with it to the astronomers of Milan, when on his return to France; but we have still at the observatory the circle supplied at the same time and for the same purpose to Delambre, and we know that the dimensions of these instruments were so nearly the same, as to justify the application to the one of a conclusion drawn from the other. Now the telescope of this circle does not separate the stars, but represents them conjointly, under the appearance of a single ill-defined star: nevertheless the companion of ζ if it were alone in space, is of sufficient magnitude to be visible to the unassisted eye of a good observer; but the proximity to a luminous point much exceeding the object itself in brilliancy, causes the light of the two to be confounded, until the distance between them becomes sufficient for separation. Hence it follows that the point actually observed by Méchain must have been some apparent centre between the two stars, nearest to the largest, but in what proportion it may not be easy to say: we may content ourselves, at present, by remarking the direction in which a correction arising from this cause should be applied; its effect must obviously have been to increase the zenith distances of the observations below the pole, and to diminish those above the pole.

Before we can fully admit this conclusion we must, however, assure ourselves that ζ Ursæ Majoris was really double, as seen from the earth, at the time Méchain observed. This might, perhaps, appear an unnecessary question; but there are two causes (one of which, at least, is sufficiently remarkable) which require its examination. The first is grounded on the properties which modern observers have recognized in double stars. When two stars are nearly in the same direction as seen from the earth, but at very unequal distances from it, they appear as two luminous points very close to each other; but their proximity is only apparent, being an effect of projection. In this case the stars preserve always the same relative position

to each other, unless either or both may have a proper motion, or an annual parallax. But there are other groups, in which the proximity is not apparent, but real; and careful observations have taught us that these stars are physically double; that they are mutually dependent, mutually attract each other, and form a proper system moving round a common centre of gravity, the smaller star revolving round the greater. These systems, therefore, will occasionally present to a spectator on the earth, the remarkable phenomenon of one star eclipsed by another. The duration of the eclipse may appear considerable, in consequence of the apparent slowness of the motion of the satellite star around its principal. Modern astronomers are already acquainted with several varieties of such phenomena; Sir Wm. Herschel could not again distinguish the companions of several stars which he had previously seen to be double. Fruitless attempts have recently been made to discover the smaller stars in ζ Herculis and δ Cygni, long since noticed as double stars. Finally, other stars, (ζ Orionis, for example,) which were single, are now become double. It is necessary then to ascertain to which of these classes ζ Ursæ Majoris belongs, before we can assure ourselves that it was a double star at the time the latitude of Montjouy was observed by its means.

The second reason for investigating this point is an observation of M. Flaugergues, which, if confirmed, would have very important consequences in regard to our general knowledge concerning the stars. It is the only observation of the kind, so far as I am aware, that has ever been publicly stated; and it happens, curiously enough, to have been made respecting the very star in question. In the 'Connoissance des Tems,' for 1802, page 360, there is the following notice by M. Flaugergues, whose name is not without authority in astronomical observation: "I have formerly frequently observed the star in the tail of the Great Bear, ζ of Bayer, because I was in the habit of trying the power of telescopes by the apparent distance of that star from Alchor, but without discovering it to be double; looking at it with a telescope of 15 inches, on the 4th of August, 1787, at 8 p.m. I saw, with surprise, that it consisted of two stars, one large and the other small, distant from each other the diameter of the smallest. Since that time I have

frequently observed both stars, and have noticed that the distance between them has continually increased, its progress having at length become so perceptible, that they are now 15 seconds apart, which is three or four times as much as when I first took special notice of their distance. The smaller star, which is to the south, has, moreover, augmented in size and brilliancy." This note is not accompanied by any details of measurement: I know not if any were made; but, considering how particular the statement is, a further enquiry appears to be requisite; and we will therefore briefly refer to the most authentic observations existing on the star in question.

It is only lately that double stars, as such, have attracted the notice of astronomers; previously it was only the principal star of a group whose position was determined and recorded in catalogues. It is thus that Flamstead, La Caille, Lalande, and others acted in regard to double stars generally, and amongst them to ζ Ursæ Majoris. It cannot be supposed that with the instruments they employed they did not see the small accompanying star, which was noticed as existing by contemporary astronomers; but what we have since called double stars were considered by them as single independent stars, of which the principal only was deserving of attention. It is not in their works, therefore, that we can hope to find the information we seek. Another circumstance may also have limited their attention in regard to ζ Ursæ,—it comes to the meridian very nearly at the same time as Spica Virginis; and as the latter is one of those fundamental stars which were principally regarded, the observations of ζ Ursæ, it is probable, received the less attention on that account. Nevertheless, the notices which we are able to collect, though far from numerous, are sufficiently decisive to enable us to arrive at a satisfactory conclusion.

Bradley, in 1755, frequently observed both stars; he records them as being of the third and sixth magnitude, as at this day; his observations of A.R. and declination show the lesser to have been 11″.3 south of the principal star, and their angular distance 13″.9.

In a suite of observations published in 1784, by M. Bugge, a Danish astronomer, there are some of ζ Ursæ which are not very precise, but at the end of one occurs the following note:

"duo parvi comites oct. mag., una supra, alter infra stellam fere 10'."

In 1779—1781, Sir Wm. Herschel measured their distance, 14".5. Piazzi in 1792 makes the smaller star 13".3 south of the principal, and from the difference of A.R. and declination their angular distance 15".9.

From that period to 1818, I do not know of any observations having been made; but since 1818, the two stars have been examined by MM. Struve, South, and Herschel, whose measures agree in making their distance about 14".5. Lastly, I myself, in 1827, by more than twenty observations with the mural circle of Fortin at the observatory, find the lesser star always 13" south of the principal. All these results, obtained at periods so widely apart, and by means so different as micrometers and meridian instruments, may in fact be regarded as identical; the little differences they present, being of the order of possible errors of observation, cannot reasonably be ascribed to the peculiar motion of stars, whose relative position we find exactly the same in 1755, 1781, 1792, and at the present time. In comparing the results, we find nothing to authorise a belief that these stars have any mutual relation or dependence; or that a rotation round a common centre of gravity has been in progress during any part of the last 70 years. It is probable, therefore, that their proximity is merely in appearance, and is the effect of projection; and that, consequently, there is no liability of the one being eclipsed by the other. It is possible that this conclusion may at some future period be modified; but it is abundantly sufficient for the present purpose, which is to show what was the apparent state of the star at the period of M. Méchain's observations.

Admitting this conclusion, the fact stated by M. Flaugergues involves the supposition that the smaller star must have quitted the position, relative to the other, in which it had been stationary for nearly 30 years, so as to be eclipsed in 1787; and subsequently, by a motion equally rapid and in a contrary direction, resumed its former position, in which it has since remained stationary, for nearly 30 years more. It appears difficult to reconcile such a movement of rotation with our present views of the motions of the celestial bodies, and the regularity of the laws which govern them. Quitting, how-

ever, this consideration, and confining myself simply to the two points which it is my purpose to clear up, I believe that we may conclude with full confidence, that the star ζ Ursæ Majoris was double, and presented the same appearance as at present, when M. Méchain observed it at Montjouy and Barcelona.

I pass to the general examination of the observations from which the latitudes were deduced, and to their recalculation.

The stars which M. Méchain employed at Montjouy were α and β Ursæ Minoris, ζ Ursæ Majoris and α Draconis, β Tauri and Pollux, being six in all. The four first are circumpolar, and pass the meridian on both occasions north of the zenith; these were observed both above and below the pole. The two last, from their declination, could only be observed on the southern meridian.

At Barcelona we find employed α and β Ursæ Minoris, ζ Ursæ Majoris and Pollux: α Draconis and β Tauri were not observed, but Capella in their stead. At this station, therefore, there were four stars north of the zenith, of which three were circumpolar; and one only to the south of the zenith.

All these stars are not equally well situated in respect to the accuracy of the results that might be obtained with them. We should scarcely deem, at the present day, the selection equal to a determination so important as the latitude of one of the extremities of an arc of the meridian. Some, by being too near the zenith, give too great a value to errors arising from defect in verticality of the plane of the circle, and these also in their passage below the pole descend to zenith distances so great, as to be affected by irregularities of refraction: α and β Ursæ Minoris, β Tauri and Pollux, unite nearly all the conditions that make them suitable; but Capella, ζ Ursæ Majoris, and α Draconis are at zenith distances not greater than $4\frac{1}{2}°$, $14\frac{1}{2}°$, and $16\frac{3}{4}°$ in passing the meridian above the pole; and the two latter pass below the pole at the low altitudes of 16° and $7\frac{1}{2}°$.

Some of the errors which might be looked for from these causes, appear to have been remarkably kept within limits by the great skill and pains of the observer; but it was not in his power to destroy them altogether, and those which remain necessarily exercise all their influence on the results, in conse-

quence of the method which he was obliged to employ to arrive at the results.

On examining the calculations of latitude in the second volume of the 'Base du Systême Métrique,' it is soon perceived that they had been preceded by a previous calculation, the object of which was, to derive from the double passages of the circumpolar stars, the declinations which are afterwards employed as elements in the reduction of the observations, regarded separately as independent zenith distances.

To us at present such a mode of proceeding may appear strange, but in those times the means within the command of MM. Delambre and Méchain afforded no better mode. The great work of Piazzi had not then appeared; they had only the catalogues of Bradley, Meyer, Lacaille, and Lalande, in which the elements of reduction employed had not the precision which new and more exact observations have given. I have examined the declinations of the stars they employed, such as they might have been derived from the catalogues above-mentioned, and I find the discordances so great, that even a mean amongst them affords no sufficient guarantee. They were thus obliged to have recourse to that method which derives both the latitude and the declination at the same time from the double passage of a circumpolar star. This method, which was the most esteemed at that period, possesses decided advantages when stars only are used which are very near the pole, such as α and β Ursæ Minoris, in which case the latitude and declination are affected only by instrumental errors; but at greater distances the errors of refraction are involved, as well as others which may be peculiar to a certain star from any unknown cause.

We may now perceive, in the employment of this method, the source of the anomaly which the observations with ζ Ursæ Majoris present at Montjouy and Barcelona. The declination of the star, derived from its double passage of the meridian, is influenced by the errors arising from the irregularity of refraction in the passage below the pole, the possible defect of verticality in the instrument in the passage above the pole, and in both by the apparent though erroneous place to which the star is in either case referred, in consequence of its double nature. Possessing advantages now which did not exist in the

former period, we may adopt a mode of calculation in which these several errors are no longer involved confusedly. We have only to take the declination of the star from modern catalogues, the precision of which we can thoroughly rely upon, and apply it directly to the corrected zenith distances.

The declinations of α and β Ursa Minoris, employed by M. Méchain, are so nearly the same as those of our present catalogues, that I have left them unaltered. But it is not so with respect to the other stars. The sources, therefore, from which I have sought to correct them are the following:—

First, Bradley's catalogue, reduced afresh, and compared with Piazzi's by Bessel, gives the declinations in 1755. These brought up to the 1st January, 1794, make as follows:—

	° ′ ″		° ′ ″
Capella . .	45 46 09,86	α Draconis . .	65 21 52,46
β Tauri . .	28 25 02,50	ζ Ursæ Majoris .	56 00 19,96
Pollux . .	28 30 33,41		

I then take the declinations of the same stars; First, in Bessel's catalogue of 1820, drawn from his own observations, in Zach's Corr. Astro., 1822, cah. 3; second, in Pond's Catalogue for 1826, from the Greenwich observations made with the two mural circles, Schumacher's Astro. Nach. No. 119; third, in Brinkley's Catalogue of 1813, also in Schumacher's Astro. Nach.; fourth, and lastly, I have myself calculated them from a great number of observations made by my colleagues and myself at the observatory at Paris with the mural circle of Fortin.

These declinations referred to the 1st January, 1820, by applying the annual variation of the respective stars, give the following results; the agreement of which attests the great precision with which such astronomical elements are obtained at the present period:—

DECLINATIONS FOR JANUARY 1, 1820.

From the Observations of	Capella.	β Tauri.	Pollux.	α Draconis.	ζ Ursæ Majoris.
Pond .	45° 48′ 10″,30	28° 26′ 42″,10	28° 27′ 07″,10	65° 14′ 19″,40	55° 52′ 05″,60
Brinkley	10,79	41,84	06,98	. .	. .
Bessel .	09,12	40,40	05,54	. .	. .
Paris .	10,38	43,66	07,65	19,52	05,84
Mean	45 48 10,15	28 26 42,00	28 27 06,82	65 14 19,46	55 52 05,72

In reducing these declinations to the 1st January, 1794, which is the epoch nearly of M. Méchain's observations, I have computed the precession by the formula at length, employing the constants determined by M. Bessel, in a memoir published in the 'Connoissance des Tems' for 1829. I thus obtain,—

	Capella.	β Tauri.	Pollux.	α Draconis.	γ Ursæ Majoris.
	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″
Declinations, Jan. 1, 1794. By Bradley & Piazzi .	45 46 11,11 45 46 09,86	28 25 02,94 28 25 02,50	28 30 33,79 28 30 33,41	65 21 52,06 65 21 52,46	56 00 19,58 56 00 19,96
Mean . .	45 46 10,48	28 25 02,72	28 30 33,60	65 21 52,26	56 00 19,77
Base du Syst. Mét. . .	45 46 10,00	28 25 01,10	28 30 37,33	65 21 50,58	56 00 16,70
Differences	+0,48	+1,62	−3,73	+1,68	+3,07

Such are the errors of the declinations employed in the 'Base du Système Métrique.' In recalculating the latitudes with them by the usual method of absolute zenith distances, I have computed the apparent places for each day of observation, by employing 20″,255 for aberration, and 18″,036 for nutation.

Lastly, I have verified the calculations of refraction, and the reduction of the zenith distances; but in these I have found no other corrections required in the published account, than of several typographical faults, which, however, very rarely occur in any of the definitive results.

The following tables contain the series for each star recalculated.

LATITUDE OF MONTJOUY.

ζ URSÆ MAJORIS.

PASSAGE ABOVE THE POLE.

1793.	Apparent Declination.	No. of Obs.	Latitude.
Jan. 7	56°. 0′. 24″,61	6	41°. 21′. 43″,15
8	24.52	8	43,55
10	24,30	8	43,09
12	24,12	10	46,16
14	23,93	10	46,25
15	23,84	10	43,28
18	23.68	12	45,27
19	23,60	10	46,77
20	23,12	8	46,13
	Mean of	82	41.21.44,98

PASSAGE BELOW THE POLE.

1793.	Apparent Declination.	No. of Obs.	Latitude.
Jan. 3	56°. 0′. 25″,15	10	41°. 21′. 35″,28
4	25,02	12	38,90
6	24,75	14	36,96
7	24,62	12	33,72
8	24.52	8	33,56
10	24,29	14	41,61
11	24,19	12	38,10
	Mean of	82	41.21.36,18

α DRACONIS.

PASSAGE ABOVE THE POLE.

1793.	Apparent Declination.	No. of Obs.	Latitude.
Jan. 22	65°. 21′. 55″,09	12	41°. 21′. 47″,18
23	55,03	12	46.84
25	54,92	12	45,64
27	54,87	12	47,52
29	54,82	12	49,37
31	54,80	12	47,14
	Mean of	72	41.21.47,28

PASSAGE BELOW THE POLE.

1793.	Apparent Declination.	No. of Obs.	Latitude.
Jan. 13	65°. 21′. 55″,89	14	41°. 21′. 40″.98
14	55,76	14	42,92
15	55,64	10	39,22
16	55,56	14	44.51
19	55,30	12	46,17
20	55,22	6	46,08
	Mean of	70	41.21.43,15

β TAURI.

1793.	Apparent Declination.	No. of Obs.	Latitude.
Feb. 4	28°. 24′. 52″,05	8	41°. 21′. 40″,44
5	52,06	8	44,23
6	52,07	8	43,24
8	52,11	8	46,21
10	52,15	8	46,40
11	52,17	6	40,95
13	52,21	10	41,49
14	52,23	8	46,17
20	52,33	8	42,23
21	52,34	8	43,71
24	52,37	8	46,27
	Mean of	88	41.21.43,76

POLLUX.

1793.	Apparent Declination.	No. of Obs.	Latitude.
Mar. 25	28°. 30′. 33″.91	8	41°. 21′. 42″,97
27	33,99	8	42,12
28	34,03	8	42,12
31	34,16	8	45,24
April 2	34,17	8	47,06
	Mean of	40	41.21.43,90

LATITUDE OF BARCELONA.

ζ URSÆ MAJORIS.

PASSAGE ABOVE THE POLE.				PASSAGE BELOW THE POLE.			
1794.	Apparent Declination.	No. of Obs	Latitude.	1793, 1794.	Apparent Declination.	No. of Obs.	Latitude.
Jan. 5	56° 0′ 7″,63	10	41° 22′ 48″.27	Dec. 24	56° 0′ 9″,69	12	41° 22′ 42″,11
6	7,50	10	46,96	25	9,48	14	40,19
9	7,15	10	46,31	26	9,28	6*	40,87
12	6,84	10	46,48	27	9,12	12	43,21
15	6,75	10	46,08	Jan. 1	8,25	12	42.07
16	6,51	10	46,22	3	7.93	12	40,02
17	6,45	10	46,79	4	7,81	12	41,78
18	6,38	10	47,73				
	Mean of	80	41 22 46,73		Mean of	80	41 22 40,47

CAPELLA. PASSAGE ABOVE THE POLE.				POLLUX. PASSAGE BELOW THE POLE.			
1794.	Apparent Declination.	No of Obs.	Latitude.	1794.	Apparent Declination.	No of Obs.	Latitude.
Feb. 15	45° 46′ 10″,76	6	41° 22′ 46″.30	Mar. 25	28° 30′ 28″.08	8	41° 22′ 40″,80
18	10,81	6	44,63	29	28.03	8	41,8
19	10,83	6	44,03	31	28,32	8	42,1
20	10,87	6	48,30	April 1	28,37	8	40,5
21	10,90	6	44,61	2	28,42	6	41,84
25	11,03	6	43,27	3	28,47	8	43,8
Mar. 3	10,94	6	43.21	5	28.57	6	40,31
4	10,87	6	44.78	6	28,62	8	41.61
5	10,80	6	46,27	8	28.75	8	42.6
6	10,73	6	44,73	14	28.89	8	42,6
9	10,54	6	42,07	15	28 92	6	42,07
10	10,48	4	44.77	16	28.95	8	42.5
14	10,52	6	47,19	17	28,98	6	44,4
15	10,54	6	41,50	18	29,01	8	40,1
16	10,55	6	43 25				
23	10,32	6	46.22				
24	10,31	6	44,18				
25	10,28	6	42,91				
	Mean of	106	41 22 44,51		Mean of	104	41 22 41,9

These tables shew clearly the sources of the anomalies to which I have adverted in the case of ζ Ursæ Majoris; the passages of the meridian below the pole give a latitude obviously incorrect: compared with the result of all the other series north of the zenith, it presents a difference in defect amounting to more than 8″ for Montjouy, and to nearly 7″ for Barcelona; from which we may presume that the zenith distances below the pole were *nearly* to the same amount too great, and we may trace approximatively the proportion of discordance which is due to each of the causes which I have mentioned. ζ Ursæ Majoris was observed at 82½° from the zenith, an altitude for which the united endeavours of mathematicians and astronomers have failed to render them master of the irregularities to which refraction is subject. Tables have been formed on different hypotheses, founded on the density and known temperature of the atmosphere; these tables have been compared with observation to verify the theory, and to determine the constants for the most convenient formulæ. Other tables have been constructed, derived from observation alone, without regard to the physical explanation of the phenomena; and lastly, general formulæ have been advanced for the refractions which, without reference to observation, are founded on the experiments of MM. Biot and Arago on the refractive powers of the atmosphere, and on those of Dalton and Gay Lussac, on the effects of changes of temperature on its density. The agreement of observation with all these tables so variously derived, from the zenith to 74° from it, shows that the refractions within such limits are independent of the law of variation in the density of the atmosphere. But beyond that limit, and more especially beyond 80°, the calculation is no longer in accord with observation. The discordances vary from one day to another, and in the same place, although the barometer, thermometer, and hygrometer are stationary. It would be necessary to know the differences of density and temperature of all the various strata of the atmosphere traversed by the ray which passes little above the horizon; but meteorological instruments acquaint us only with what is passing immediately around the observer: thence the difficulty of representing low refractions by an exact

formula; and thus all the tables of refraction, for greater zenith distances than 74°, are to a certain degree empirical. The method suggested by M. Laplace causes the French tables to be less so than others, and as far as 80° they may be employed without considerable error; but at the distance of 82½°, which is that of ζ Ursæ Majoris, the errors may be estimated at from 4″ to 5′. The recent researches of MM. Brinkley and Groombridge show that it is rare at that distance to obtain even the mean results of different observers in accordance with each other.

We thus perceive that the discrepancy of the latitude derived from the passages of this star below the pole was produced by irregularity of refraction, combined with errors arising from the double nature of the star. Perhaps we might add the possibility of error in the direction of the telescope, occasioned by the dispersion of light in the atmosphere: were the whole of the image of a star constantly visible, this dispersion would occasion no error, for the centre of the dispersed rays would still be the true centre of the object; but in the supposition that a part of the rays might be intercepted, either by being absorbed by the vapours with which the horizon is charged, or by the manner in which the field of view of the telescope may be illuminated, the apparent centre of the image would no longer be the real centre of the object. The numerous experiments of M. Arago on this subject show, that in certain cases this displacement of the apparent centre takes place to an amount which is very sensible.

The latitude deduced from the passages above the pole of ζ Ursæ Majoris presents no anomaly; here no irregularity of refraction interfered, and the other sources of error appear in great measure to have compensated each other, since the result is comprised within those limits of difference which are found to exist between the other stars observed to the north of the zenith.

The latitude resulting from the passages below the pole of α Draconis manifests also the influence of the irregularity of refraction at low altitudes; it is in defect about 3″, an error in the same sense as in the case of ζ Ursæ Majoris.

Under these circumstances, the part which should be taken

in reference to the latitudes obtained by these stars admits of no hesitation; the results below the pole should be rejected, and those above the pole preserved.

To deduce, in the most advantageous manner, from the results thus preserved, and from the results of all the series with the other stars in which no remarkable difference from the mean is observed, we must adopt a mode of combination essentially different from that employed in the 'Base du Systême Métrique,' and of which experience subsequent to that period has established the preference. It is now known, that however skilful the artist by whom a repeating circle has been made, and notwithstanding the utmost attention which an observer can bestow on the adjustments, the zenith distances observed with it are still liable to be affected by certain errors which have obtained the name of "constant errors," but which are nevertheless constant only in a certain sense; since the transportation of the instrument from one station to another, or the mere laying it by, and putting it together again at the same station, may cause an alteration in the bearing of the parts relatively to each other, and thus a change in the amount of error. It is now therefore admitted, that, whatever may be the nature and sources of such errors, the best mode of obtaining latitudes free from their influence is, to observe several series of well-known stars both north and south of the zenith, and, as far as may be possible, at equal distances from it; then if the mean result of those observed to the north gives the latitude in excess or in defect, the mean result of those observed to the south will give it erroneous to an equal amount but in an opposite direction, and the mean of the two will be the correct latitude.

In applying this method to the observations of M. Méchain, we shall at once perceive that it affords an explanation of the supposed difference between the latitudes of Montjouy and Barcelona: hardly, indeed, had the method been established, before this was inferred by those who were engaged in similar operations: at a meeting of the Bureau des Longitudes in November, 1818, M. Arago, whilst reading an account of the mode in which M. Biot and himself had proceeded in determining the latitude of Dunkirk, remarked, that the latitude of Barcelona, deduced in a similar manner from the

northern and southern stars, accords with the geodesical measurements.

Happily M. Méchain observed β Tauri and Pollux to the south of the zenith. He has himself expressed regret at his choice of these stars, and still more in having employed ζ Ursæ Majoris. With regard, indeed, to the last named star, it was matter of just regret; but if he still lived, he would, without doubt, on the contrary, rejoice, to find that those two stars south of the zenith are the means of preserving the whole work. The several series of Pollux and β Tauri, compared with those of the northern stars, show the existence of unsuspected errors in the circle of M. Méchain of the nature of those to which we have alluded. The latitudes observed to the south of the zenith are less than those to the north, and the difference is greater at Barcelona than at Montjouy. But all are in accord by the application of the new method of combination; the anomalies disappear; the latitudes of Barcelona and Montjouy agree, or at least present only the small difference of 0″,21, which is well within the limits of probable error of observation, and which it would be an unnecessary refinement to endeavour to remove by further research.

The following table contains the conclusions in regard to the several stars, and to both the latitudes:—

MONTJOUY.

	Star	Obs.	°	′	″
Stars observed north of the zenith.	α Ursæ Minoris, pass. sup. et inf.	326 obs.	41	21	44,91
	β Ursæ Minoris, pass. sup. et inf.	288 do.			45,21
	ζ Ursæ Majoris, pass. sup.	82 do.			44,98
	α Draconis, pass. sup.	72 do.			47,28
	The four stars	768 obs.	41	21	45,25

	Star	Obs.	°	′	″			
Stars observed south of the zenith.	β Tauri,	88 obs.	41	21	43,76			
	Pollux,	40 do.			43,90			
	The 2 stars,	128 obs.	41	21	43,81	41	21	43,81
	Latitude observed at Montjouy					41	21	44,53

BARCELONA.

Stars observed north of the zenith.	α Ursæ Minoris, pass. sup. et inf.	208 obs.	41° 22′ 47″,43
	β Ursæ Minoris, pass. sup. et inf.	228 do.	48,37
	ζ Ursæ Majoris, pass. sup.	80 do.	46,73
	Capella	106 do.	44,51
	The four stars . . .	722 obs.	41 22 46,19
South of the zenith.	Pollux . . .	104 do.	41 22 41,95

Latitude observed at Barcelona . . .	41 22 44,07
Reduction to Montjouy . . .	— 59,33
Latitude of Montjouy deduced from the observations at Barcelona	41 21 44,74
Latitude of Montjouy observed . .	41 21 44,53
Difference	0,21
Mean	41 21 44,635
Reduction to the centre of the Tower of Montjouy	— 0,100
Latitude of Montjouy	41 21 44,535
Latitude adopted in the Base du Systême Métrique	41 21 44,960
Correction of the latitude of the extreme station of the Arc of the Meridian	0,425

The final latitude deduced for the southern extremity of the arc of the meridian between the parallels of Dunkirk and Montjouy is 45° 21′ 44″,535; being less by 0″,42 than that adopted by the commission of weights and measures. But the great mass of observations combined in this determination, and the verification of the calculations which I have now made, appear to me to entitle it to great confidence. It is founded on 134 series, comprising 1722 observations, whilst the former rested on 44 series, comprising only 756 observations.

One reflection naturally suggests itself from this Memoir; the anomalies which have caused so much trouble and uneasiness can no longer be attributed to faults in the observer, or to the effects of local attraction; they were caused solely, as we have seen, by the imperfect state of our knowledge; an imperfection of which we are now ourselves aware. In perusing the notice of M. Méchain's life, and the fragments of his correspondence, published by M. Delambre, his friend and biographer, it is impossible to avoid a lively sensation of regret, in witnessing the deplorable influence that a matter, which now appears to us so trivial, exercised on the whole course of his

latter years. From the moment that his mind dwelt on these supposed errors, from the day when he adopted the fatal resolution of concealing the principal one, in the hope of returning to verify his observations, the happiness which he had hitherto enjoyed entirely forsook him. The weight of his secret, the accident which endangered his life, his wearisome captivity, the fatigues which he endured with so much perseverance, the separation from his family at that unsettled period, without obtaining tidings of them for many months, all combined to change his character, and to produce a state of melancholy, reserve, irresolution, and sometimes of apparent indifference and inactivity, which his friends in vain sought to comprehend or to overcome. Ten years were passed in crosses and disappointments which embittered and shortened his life. Méchain died at a distance from his country, his family, and his friends, a victim to the zeal and devotion with which he pursued the objects of his employment; and deprived of that period of life when he might have enjoyed the consideration and celebrity to which his services so justly entitled him. His name, inseparable from that of Delambre, remains, however, honourably attached to operations which will preserve the high station assigned to them amidst the achievements which distinguish the progress of science in the eighteenth century.

J. N. Nicollet.

On the Annealing of the Specula of Reflecting Telescopes.—By J. Mac Culloch, M.D., F.R.S., &c. &c.

(Communicated by the Author.)

It is much more than twenty years since I spent some time in constructing specula for reflecting telescopes; nor, till very recently, had I any reason to conjecture that in any part of the process, which it was my lot, like that of others, to labour through for myself, I was possessed of knowledge which was not equally known to every one who had attended to this subject—much more to the makers of such telescopes. Having lately, however, had an opportunity of conversing with Mr. Ramage about his processes, I believe that there is one point at least which has been misunderstood, and, consequently,

often mismanaged: the result being the production, by accident, of good metals, perhaps one good metal only, among many failures, when, if I am right, those may be produced with comparative certainty, and possibly, in such hands as those of Mr. Ramage himself, with absolute precision. It may perhaps, indeed, be considered that it is wrong here to suppose that because this excellent constructor has overlooked a necessary portion of his process, others should be supposed to have done the same: but as I have no means of ascertaining what is the knowledge and practice of the different makers, I must even hazard the chance of here attempting to teach any one what he knew before; while I must still trust that some may hereafter derive, from my experience, precautions by which they will be saved considerable disappointment and some expense. Such is the apology for this paper, should it prove superfluous to any one: while I cannot help considering the subject as of some importance, as, not merely the colour of the metal, but, as I think, its durability, and its power of giving a clear image, depend much on the nature of the management in that part of the process to which I allude.

I am not aware that it is necessary to say anything respecting the proportions of the two metals in the alloy; though I would caution makers of specula respecting the purity of the tin and copper, being convinced by some trials that the presence of arsenic is apt to lead, in time, to the tarnishing of the surface. I must equally presume that every one is acquainted with the temperature required for the separate metals before mixing, with the necessary flux, the method of pouring in the alloy, the position of the mould, and so forth; though with respect to the best form of the metal itself, that is, as to relative thickness in its several parts, I must confess that I have never yet been able to satisfy myself: such are the complicated difficulties, entangled between the cooling and annealing first, and the optical consequences afterwards depending on changes of temperature, and on weight or flexure, that beset any calculations on this subject; while it is probable that they are really irreconcileable, or that there is no one form which will be the best, as concerns the original nature of the metal and its action when completed.

To pass from these points, therefore, the object to which I am desirous of especially calling the attention of those who may be interested in this question, is the process of annealing the metal after casting, since it is in this, as far as I have found, that the chief disappointments take place; and in consequence of a species of mismanagement which attention will be able to prevent, when once the principle has been explained. Here it is at least that I did fail myself, until I contrived to examine and discover the cause; and here it is that Mr. Ramage has found the same difficulties, and made the same failures—not likely, I trust, to happen often again, though, in a process so delicate, certainty must not always be expected.

I need scarcely say, that if this alloy were suffered to cool rapidly, it would break, or might break, and that it requires to be cooled slowly in the mould, or annealed; this being true, particularly of the larger metals, as there is not so much hazard with respect to small ones. The process itself is simple and easy: it would scarcely, indeed, be necessary to describe it were it not for its frequently injurious consequences; and it consists commonly in covering the metal in the mould with hot ashes or cinders, and thus retaining it, often for a considerable time, and at a high temperature.

To state now what those failures are, before enquiring into the cause,—I must first remark, that the fracture of speculum metal ought to be that which mineralogists term flat conchoidal, or resembling that of gun-flint; and the surface of the fracture ought to be lucid and smooth, or like that of glass, utterly free of granulation or roughness of any kind, and as polished in reality, as it can afterwards be rendered on the tool. Without this, it is in vain to expect the greatest light which a speculum is capable of giving, nor the purest colour; and without this also, it will be found that the surface will be apt to fail after long use, or in consequence of frequent exposure to the atmosphere and vacillations of temperature. A speculum metal, therefore, which does not thus come out of the annealing, ought to be rejected; it is not worth the subsequent abour.

It is true, that, as far as four inches diameter, a very moderate degree of care will generally insure success; the difficulty

occurs in the larger ones, and increases rapidly with their increase of size. And the failure consists in the reverse of what I have just stated. The fracture becomes granular or rough, and is at the same time dull, as might be anticipated; while the degree of this fault varies with the extent of the mismanagement; which is a mismanagement in the annealing alone, as I shall presently show, while the nature of the metals used, or something in the flux, or in the casting, is often accused for faults depending on a much simpler cause.

Nor is it only that the metal is dull from the nature of the fractured surface, or that this is a mere deception which the polishing will remove. So far from that, the absolute colour of the alloy itself is imperfect or bad; it has no longer that clear silver whiteness which will take what is technically called a black polish, but is grey, and sometimes of different tones—often so grey and so dark, as to be palpably unfit for its purpose, though often, in the least imperfect instances, retained and finished for use, with the production assuredly of some disappointment, even at first, and of somewhat more, I have fully ascertained, after long use, as I shall presently explain.

In such cases of extreme failure, as the blame is generally laid on the metals of the alloy, the fault remains uncorrected; and if others have found the same difficulties as I at first encountered myself, and as Mr. Ramage had always done, when I inspected his processes, they will be well pleased to know where the error lies; though it must still depend on a nicety of attention which it is impossible to describe, to find the remedy.

Could the speculum be suddenly or quickly cooled after casting, it would be always perfect; the evil is the result of slow cooling—of that very process which is necessary, or thought necessary, to secure its integrity: and the slower the cooling, the greater the evil or the failure. Or, by rapid cooling, the texture and the colour are the most perfect which can be obtained from this alloy: while it is possible, by a proceeding as highly reverse as possible, to render it absolutely useless, and utterly unlike to what is desired; and even while the most rigid analysis shows, that the bad metal and the good are precisely the same after having been cast, if we

should not be satisfied as to this, from having produced by those different treatments, a perfectly good and an extremely bad metal out of the same pots at the same time.

There ought now to be no difficulty in seeing what the efficient cause of this evil is. It is the crystallization of the alloy, permitted or encouraged by the application of too high a heat in the annealing, and by continuing that heat too long. Nor is fluidity necessary to this process; it occurs after the metal is consolidated, as I have amply proved; since it is even easy to bring a metal to this state by annealing, after having been thoroughly well cast and annealed, and after having been tried by fracture. Nor is it a fact to excite any surprise, since it belongs to a wide train of analogies on which my experiments, long since ready to be made public, amount perhaps to thousands.

We can now, therefore, trace the cause of all those variations of defect, which occur in this case, between the best and the worst specimens; as it will be found that the degree of crystallization on which depends the faults, are always proportioned to the extent to which the annealing process has been carried; or, on the duration and the intensity of the heat applied to the metal after consolidation. The reason of this, also, is apparent: but I need not, in this merely practical notice, enter into a subject which I have treated fully in a paper of another nature.

But to convince observers that this is the real cause of the defect of such metals, it is always easy to dissect the crystallization, if I may use such a term, by means of an acid, and thus to see how the defect goes hand in hand with the crystallization, while the variety of texture in speculum metals thus discovered, will also be found very considerable, and often, I may add, very unexpected; since, among other singular varieties not easily described, I have found even examples of what mineralogists call the spheroidal concretionary structure.

But if I dare not here dwell on the properly theoretical part of this subject, I must suggest one circumstance or change, which, under high or extreme degrees of annealing, seems to occur, and which is probably the real cause of the defect as to colour, since it is not so easy to suppose that mere

texture could produce a gray tint, such as is often found in these defective metals. I call it a suggestion, because, while engaged in these investigations, I was never able to discover any method of analysis by which the fact, if it be one, could be ascertained.

The suggestion is simply this,—that under the complete liberty of crystallization permitted by high and long-continued heat, an alloy is formed different from that which was intended; or that a certain definite combination takes place between the tin and copper, so as to produce a mixture which is possibly that of two alloys, or else is such as to set a portion of one or other of the metals free, though of course under a state of mixture which is unassignably minute. It is plain that this is at best a probable state of things, while I need not say how difficult the proof must be at present. It is probable, for this reason: there is a crystallized metal or alloy, crystallization takes place only in simple bodies or definite compounds, and it would be very singular if the proportion of twenty-five copper and twelve tin, which was my compound, should be that definite compound, while as other proportions are used by Mr. Ramage, such an occurrence cannot, plainly, happen in both cases. And in defect of analysis, it has often seemed to me, on the trial by acids, that there was more than one substance in the defective and crystallized speculum, distinguishable by the manner in which the acid acted on the surface. It might not be very difficult to approximate to this point to a greater nicety by the application of different acids, and by a subsequent examination of the proportions of tin and copper dissolved; but what I neglected to do when I had the power, my state of health has long prevented me from following up.

It seems unnecessary to add more on this part of the subject in a paper so merely practical; and if I ought now to show how the annealing ought to be carried on so as to avoid the evil in question, I find it very difficult to give such directions as will enable any one to do as I have done in these cases with success. And, indeed, it can scarcely be necessary; since the general principle, and the cause of the evil having been once explained, it will be easy for the speculum-maker to apply what, after all, must be a matter of trial, and which

must also vary with each magnitude of speculum. I could not describe a temperature for which there is no measure, nor lay down a period of time which must depend partly on that temperature, and partly on the size of the metal, and partly also, I may add, on its form and thickness, and even on the temperature of the atmosphere. But if each maker must feel his way for himself and for each size that he may cast, let him always remember, that the speculum metal is rather a mixture than a true alloy, and that it has a tendency to separate as to crystallize, when under liberty, by heat; that the best and most brilliant metal is that which cools most suddenly, or which is soonest deprived of the power of crystallizing, and therefore that his object must be to cool his speculum as rapidly as it can possibly be cooled without breaking. And as to the practical method of annealing, I may add, that I think the ordinary mode bad, inasmuch as it is difficult to regulate. Whether my own method may prove better in other hands or not, it is not for me to pronounce, but it was to use sand for that purpose. In this case, the mass of sand was placed over a horizontal iron-plate flue, so as to be at a high red-heat in one place and to cool gradually at another; and while the speculum was placed in the hottest part after casting, it was slowly moved to the cooler parts till the desired end was obtained.

I have but one other suggestion to offer as to the effects which have seemed to me to follow from polishing, for use, specula, of which the texture had been thus crystallized. Whether there should be two alloys, or an alloy and a metal, or not, or whether the whole result is mechanical, depending on the intersected surface of this confused crystallization, it is certain that a polished surface of this nature is irregular in its action on light, and that good images are scarcely attainable, from optical causes that will be sufficiently obvious, to say nothing of an absolute loss of light produced by this cause. And I have further reason to believe from numerous experiments, which it would be impossible as improper to detail here, that such crystallized specula, undergo further changes of their crystalline texture from the ordinary vacillations of temperature to which the uncrystallized ones are either less subject, or from which they are exempt; the consequence being a slow

deterioration, as may easily be imagined without further explanation. To this cause, indeed, we must, I believe, trace some of the deteriorations of specula which do not depend on tarnish or corrosion, though I must also add, in concluding, that the crystallized specula are more easily tarnished than others, probably from the irregular action of moisture on them, or, possibly, because the definite compound and its associate thus intermixed, one or other, or both, offer less resistance to the air than that mixture of tin and copper which constitutes a good speculum.

On the concealed Agency of Carbonic Acid in determining the Decomposition of Water by the Contact of Iron. By Marshall Hall, M.D. F.R.S.E. &c. &c.

A series of experiments were made several years ago, nearly simultaneously by M. Guibourt and myself, upon the question of the decomposition of water by the contact of iron*. Previously to this period, it was generally admitted, by the chemists of this country at least, that iron possesses the property of decomposing water†. M. Thenard, indeed, held the opposite view, that iron does not decompose water at ordinary temperatures, and founded upon it the definition of the third section of his interesting classification of the metals. This discrepancy of opinion was not removed by the two series of experiments above alluded to, M. Guibourt having concluded, that although iron does not decompose water when it is in small proportion to the fluid, yet, that a decomposition is effected when the relative quantity of the metal is great. My own experiments, on the contrary, appeared to establish the fact, that water does not undergo decomposition by the contact of iron, when both are perfectly pure.

The two Memoirs published by M. Guibourt and myself,

* Journal de Pharmacie, tom. iv. p. 241; Journal of the Royal Institution, vol. vii. p. 55.

† Davy's Elements, p. 385; Thomson's System, ed. 5th, vol. i. p. 368; Henry's Elements, ed. 7th, vol. i. p. 105 &c.

were noticed by M. Thenard in the eleventh volume of the 'Annales de Chimie et Physique;' at least that paper is particularly quoted, and its conclusions adopted, by M. Thenard in the later editions of the 'Traité de Chimie'.* The accuracy of my experiments, and the justness of my conclusions from them, are admitted; whilst the opposite result obtained by M. Guibourt, is attempted to be explained, not upon the principle of a greater relative quantity of the metal compared with that of the water, but by the agency of galvanism, supposed to be excited by a circle formed by the iron, a portion of oxide, and the water.

Such was the state of the question, when I undertook a fresh series of experiments upon this subject, two or three years ago. These experiments appear to me to have finally removed the obscurity in which this action of iron and water was involved, to have confirmed my former conclusions, and to have brought to light some new and interesting facts.

The first of these facts is, that in every case in which water is decomposed by the contact of iron, there is necessarily the superadded agency of carbonic acid; the second fact, which is a consequence of the former one, is, that in every such instance of the decomposition of water, the process is immediately arrested, by the addition of some substance which shall effectually absorb and remove that acid. These facts bear upon two chemical questions: the first, the analogy which exists between the diluted carbonic acid and some other diluted acids, in their chemical action upon iron; the second, the question of the action of water and iron in ordinary circumstances, already noticed. I purpose, therefore, to divide this Memoir into two sections, relating to these points respectively.

The first object of the present Memoir, is to show, by the detail of a series of experiments, that the carbonic acid accords with that general law which is known to obtain in regard to the sulphuric, the muriatic, and some others, in determining the decomposition of water which is placed in contact with iron.

In order to resolve this interesting question, it was necessary, in the first place, to ascertain whether iron in contact with pure water induces any decomposition of that fluid.

* See ed. 4e, tom. ii. p. 19.

The bulb of a retort was filled with small portions of iron, the interstices between the pieces of metal, together with the greater part of the tube of the retort, were then occupied with freshly-boiled distilled water, and a small portion of olive oil was poured into the tube to exclude the atmospheric air; the retort was then left in an inverted position. It was very long before any chemical change was observed. But, at length, bubbles of gas were seen to ascend to the upper part of the bulb of the inverted retort, and the pieces of iron became tarnished. This effect was observed to take place much more quickly in a similar experiment in which no oil was poured into the tube of the retort, and in which the atmospheric air was consequently not excluded; the first bubbles of gas were much earlier observed at the top of the bulb of the retort.

Suspecting, in these experiments, the superadded influence of carbonic acid, of which a minute quantity might be retained by the boiled distilled water in the first of these experiments, and of which a larger quantity might be absorbed from the atmosphere in the second, I wished to adopt some unequivocal mode of abstracting every portion of the carbonic acid from the water used in them. In a third experiment, I took the retort, into the tube of which no oil had been poured, and in the bulb of which bubbles of gas were now rapidly forming, and dropped into it a small lump of lime, which I concluded would seize the whole of the carbonic acid. From this moment the evolution of gas entirely ceased, although it had been previously proceeding for many days uninterruptedly.

It appeared to me quite plain, from this last experiment, that the appearance of bubbles of gas, observed in the two preceding ones, had arisen from the decomposition of the water, the oxygen being seized by the metal, and the hydrogen being evolved in the form of gas; that this decomposition had been effected by the superadded agency of carbonic acid, and that it was arrested when the influence of this acid was abstracted by the lime. To determine these points still more distinctly, I resolved to try the comparative effect of lime-water, and of water mixed with lime-water, and

with calcined magnesia, in the first place; and of water impregnated with carbonic acid gas, in the second.

In two experiments, I placed a quantity of iron in contact with lime water, and with water and lime-water mixed in the proportion of four-fifths of the former and one fifth of the latter. There was not, in either case, after the lapse of a very long time indeed, any oxidation of the iron or evolution of gas.

In another experiment, I placed the iron in water in which I had mixed some freshly-calcined magnesia. There was, in this case, as in the former ones, no apparent chemical change.

I now contrasted with these experiments, one in which I placed portions of iron in water impregnated with carbonic acid gas. There was a very speedy and rapid disengagement of gas, which was proved to be hydrogen by being exploded with a mixture of atmospheric air. A small portion of lime being dropped into the retort, the disengagement of gas immediately ceased.

It cannot be uninteresting to find, that the carbonic acid coincides in the same law and mode of action with iron, and probably several other metals, as the sulphuric and the muriatic, in co-operating to induce the decomposition of water placed in contact with them. Whatever establishes and extends any law in science, may be truly said to advance our knowledge far more than the discovery of the mere fact alone. It is on this ground that I trust the preceding part of this Memoir may not be deemed uninteresting.

The second object of this Memoir is to discuss the question of the mutual action of iron and water, under more ordinary circumstances than those which have been described.

It has been already stated that when pure iron is placed in contact with distilled water, which has been freed as much as possible from its gases by long boiling, the decomposition of the water has been effected extremely slowly. So tardily, indeed, is this effect produced, that M. Thenard has suggested that it may be an effect of the chemical agency of light*. This author has also suggested that this decomposition of the water by iron, may, in some instances, be connected with the evolution

* Traité de Chimie, ed. v. tom. 1, p. 361.

of galvanic agency*. It is plain, from the whole of the account given of this subject by M. Thenard, who appears to have considered it with far more attention than any other writer on chemistry, that it remained involved in the utmost obscurity. Many circumstances had led to the opinion, that water is altogether indecomposable by iron; others appeared to denote that this is not absolutely the case, but that, under peculiar circumstances, a decomposition of the water is effected by the contact of this metal. Not only light and the galvanic agency, but, as I have already stated, the relative quantities of the metal and of the fluid have been supposed to influence the result. No one appears to have suspected the necessity for the superadded agency of the carbonic acid.

That this phenomenon is not dependent upon the agency of light, is proved by the fact of its being totally prevented by the addition of a small quantity of lime water, or of calcined magnesia. And that it is not an effect of galvanism, is proved by its being prevented or immediately arrested by the same means. It is equally certain, from the same facts, that the relatively large quantity of the metal has no influence upon the result: this is further quite obvious, from the fact that the water is decomposed, however small the quantity of the iron, if the agency of carbonic acid be conjoined with that of this metal.

The decomposition of water, by the contact of iron, has indeed, in every instance, depended upon the concealed agency of carbonic acid contained in the water, or united to a portion of the oxide of the metal. This decomposition has been effected more slowly or more rapidly, according as the quantity of the acid has been smaller or greater. There is a most marked difference in the rapidity with which the water is decomposed, between a portion of distilled water which has been boiled for a short time, and another portion which has been simply charged with air expired from the lungs, into each of which precisely the same quantity of iron has been put. And in every case the decomposition of the water has been prevented or arrested by withdrawing the influence of the carbonic acid altogether.

* Traité de Chimie, tom. 1. p. 336, note; and particularly tom. 2. pp. 17—19.

The galvanic agency has been supposed by M. Thenard to be evolved by the contact of the metal and its oxide, in those cases in which the latter was present. But, in this case, the galvanic circle would not be interrupted by the addition of substances which merely abstract the carbonic acid. The oxide is, in fact, a carbonate, and the acid still exerts its agency in determining the decomposition of the water. But when this process is thus rapidly proceeding, it is at once arrested by the addition of a small portion of lime water, by means of which the carbonic acid is withdrawn, although the metal still remain in contact with its oxide.

In M. Guibourt's experiments, it is quite obvious that the agency of carbonic acid was not excluded; he speaks of removing the rust from the iron filings which he used, by merely washing them with water*. It is evident that the oxide, or rather carbonate, could be removed in this manner but very imperfectly.

It is quite plain to me that in all M. Guibourt's experiments there would have been a decomposition of the water, had sufficient time been given to allow this effect to take place. In some of my experiments, especially in those in which I had taken the greatest pains to expel the air from the water by long boiling, and to exclude it afterwards, I waited several months before I observed the slightest evolution of hydrogen gas, which, however, eventually took place in all in which the agency of the carbonic acid was not entirely excluded. The last experiments detailed by M. Guibourt led to a more prompt decomposition of the water, because the quantity of carbonic acid was obviously greater in them.

I propose, now, to conclude this short Memoir by a few remarks, rather of a desultory kind, which, however, naturally flow from the facts which have been stated.

M. Guibourt was led, by his experiments, to doubt the correctness of M. Thenard's definition of the third section of his classification of the metals, one part of which was, that they did not induce any decomposition of water at ordinary temperatures. It is plain, however, from the facts which have been

* Page 248.

detailed, that this part of the definition is strictly true in regard to iron, one of the five metals included in that subdivision. I consider this point of some importance; for the classification of M. Thenard appears to me singularly useful in the study of the properties of the metals.

It may be observed, from the experiment first detailed in this paper, that it is impossible totally to deprive water of its uncombined gases by the longest boiling. I was never able to preserve iron and water together, without the eventual decomposition of the latter, until I adopted the plan of withdrawing the carbonic acid by means of lime water or magnesia.

I would now observe, that it is not impossible that the principles elucidated in this paper may be useful in the arts, and especially that they may suggest the proper means of preserving polished iron goods free from tarnish or rust in damp weather or situations. This object would be effectually attained by covering their surface with lime mixed with water.

I would state, in conclusion, that the experiments which have been detailed were all made at the ordinary temperatures of the atmosphere, and at every season of the year. Some of them remained for repeated observation during a year and half, for I was anxious that there should remain no source of fallacy in regard to their results.

Comments on Corpulency.—By William Wadd, Esq., F. L.S.

(Continued from page 29.)

We have now to illustrate the preliminary remarks; this will be best effected by extracts from the communications of correspondents. The first extract is from a very sensible, well-informed, studious friend. He gives a succinct account of his feelings, which present an outline, or sketch, of which every practitioner in the metropolis could produce a duplicate, and of which every respectable medical man could furnish a more highly-finished portrait than this, and those which follow it. Be it so; I shall present my collection, as I would portraits of another description, feeling, that those who could give a better delineation and colouring of the facts of my

portfolio, are the persons, who will receive, with the greatest latitude, this attempt at pourtraying characters, which, from their very nature, approach to caricature.

CASES.

Monstro, quod ipse tibi possis dare.—*Juvenal.*

Case I.—*Extract of a letter from ——, Esq.*

"You have long known that I experienced much inconvenience from that *embonpoint* appearance, for which the weak and ignorant are so apt to congratulate and flatter a person. Inactivity, somnolency, depression of spirits, great nervousness, as it is popularly called, but, above all, an unwillingness, or rather inaptitude for long-continued study, were symptoms of disease which I found very much increase; and from all the attention I was able to give to the subject,—from what I had heard and read—but, above all, from its coinciding with your opinion, I was at last perfectly confident, that these symptoms principally arose from a too great accumulation of fat. It was not difficult for me to account for this accumulation, even supposing there was no natural tendency to it in my constitution. From earliest childhood I was more inclined to read than to play, and when at school, though not wanting mental activity, and possessing considerable boldness of spirits, I was averse, and of course totally unskilled, in all boyish amusements, as cricket, trapball, &c. This partly arose from my being at that period in a bad state of health, but chiefly, from having early received the strongest impetus towards the attainments of knowledge, and the ambition connected with it.

"Sedentary occupations engrossed my whole time; nor did I relax from my temperate habits, which approached to ascetic severity, till I became a student of the Temple, when I was led to indulge in all the luxuries of the age, though never in the least remitting every attention to literary attainments. Possessing, at the same time, strong powers of digestion, and being particularly partial to the most succulent aliment, as sugar, butter, milk, &c. it is easy to foresee the consequence; I became extremely corpulent.

"I had approached my thirtieth year, however, before I

experienced any great inconvenience from my increasing bulk. Since that period, I have suffered much, and at intervals have made some attempts to reduce it, but they were feeble, and not continued for any length of time. In fact, my mind was in a state of indecision on the subject, arising, like all other indecision, from the want of clear and distinct ideas, and the consequent conviction. The comparative advantage of animal or vegetable food to the general constitution of man, or to particular habits, is (strange to tell!) not yet ascertained. By far the greater part of the medical tribe are satisfied with attending only to actual disease, as being the only source of profit, while the preventive part, though far the most important, but as furnishing no emolument, is generally disregarded." From this general philippic, however, he exempted Brown, Darwin, and Beddoes, whose theories he was well acquainted with, and whom he was pleased to say, stood as "noble columns in the dreary waste."

"Here, then, was my difficulty,—I was very nervous. This arose from debility, from a want of vigour in the system. Animal food (the durable stimulant of Brown) communicates greatest strength. I tried animal food for a month, without any mixture of vegetable, eating very hearty and drinking pretty freely, but not to great excess. All my complaints increased, my nervousness in particular. It was natural then to inquire, whether this nervousness was not caused, or at least increased, by the weakness and other effects arising from my corpulence.

"I determined, then, to make trial, at least, of a vegetable diet, which I did (with two or three exceptions) for six weeks. I did not, in any respect, stint myself at first; I generally drank ale, sometimes brandy and water at my meals. I found a pint of ale at night necessary to sleep, sometimes with onions, sometimes without. I became much lighter, more inclined to continual mental exertion, but did not, in the course of a *month*, become in *the least degree thinner*. I reduced my quantity both of eating and drinking, and in a *week* was evidently *much thinner*, but found myself very feeble and little capable of exercise. I attributed this, however, to the mere effect of *change*, and as I found my spirits good, determined to persevere. I did so for another week; my debility increased, and

I was attacked by a violent *diarrhœa*, which, I should observe, was at that time (August) very prevalent. It left me extremely low, and I felt much dread at returning to a vegetable diet, and I returned to my usual course of living. My complaints again returned; I was soon fatter, had bad nights, was lethargic, and felt generally uneasy and unfit for any usual exercise of body or mind."

Observations.—The variation in this gentleman's health, from an alternate change in his regimen, was of a very decided character; and so long as he was *temperate*, he was free from the various evils that tormented him, which, the reader will easily discover, were allied to what are familiarly termed the '*blue devils*.' But he was of too sanguine a temperament to be temperate; he was intemperate in fasting, as well as in feasting; and he adopted and put in practice the theory of the day, with the zeal of an enthusiastic partisan. As he grew older, he became more decided in his personal dietetical experiments.

I have many letters of a similar nature, at different periods, in which he discusses the subject of health, all of which demonstrate, like the man in the Spectator, he was constantly destroying what he was most anxious to preserve. He read himself into one complaint, which he cured by reading himself into another. At one time he would only take food once a day; this was altered to the other extreme, eating little and often; and then he provided himself with gingerbread nuts and biscuits. For three weeks, the hour of dining was regulated, not by the clock, but the state of the stomach; the dinner was to be served, at any hour from noon till midnight, when the gastric juices were ready. At another period, he instituted a scheme of rules, by which everything was regulated by weight; and though he did not follow them with the minuteness of Sanctorius, they evince much zeal and perseverance.

By a journal he kept during the summer of 1816, he was successful in his attempts to reduce his bulk. This is applicable to our subject. It records—

"June 10. Weighed 16st. 10oz.
June 31. Weighed 16st. 1oz.

"During these 21 days the diet chiefly vegetables, milk, and tea.

"July 7. Weighed 16st.
July 21. Weighed 14st. 11lbs.
July 30. Weighed 14st. 4lbs."

At this period he became ill, having been seduced from his plans by an accidental debauch, when in a state least fitted for it. He confesses, in a note, that he rewarded his resolution, by a violent outrage on his stomach, eating all kinds of improper things, and suffering accordingly. From the manner in which he apostrophises a French pie, it appears to have distributed indigestion to the whole party of convivials, who led him astray.

Two months elapsed before he resumed his plans. In the mean time he had increased a few pounds. At the end of September he resumed his course of vegetable diet. He begins his journal with a pithy observation from his favourite, Dr. Beddoes—"No one should be content with his stomach till it has recovered that power of digesting vegetables, which it possessed in the light and joyous spring of life, and which it retains to old age, when uninjured by accident or imprudence."

"September 5.	Weighed	14st.	12lbs.
September 19.	..	14	8
October 20.	..	14	3
November 5.	..	14	1
November 21.	..	13	11"

Here the journal is continued, but so intermixed with personal reflections, that it assumes the detail of hypochondriacal thoughts and feelings, and is a very interesting document—but it ceases to be applicable to the points in question, and only gives us a notion of some of the phantasies of "a mind diseased."

Case II.—*From a fat Sportsman.*

"Having had some conversation with you upon the subject before, and hearing that you have made it a matter of study, I am desirous of inquiring your opinion further as to the safety and treatment by which weight may be diminished by *medicine.*

"I am growing heavier and fatter than I wish to be, (my ordinary weight a few years ago was fifteen stone, and I am now

increased to nineteen.) The exercise I take does not prevent it at all. *I should not quite like to be put on a regimen of abstinence*, but upon some system which, with moderate living, might gradually bring me back to about my old standard. All this time I am quite well, and should have little to complain of, were I not fond of sports which I pursued with greater convenience when I was thinner, and did I not observe that persons inclined to increase in size, lose their activity rather too soon in life."

Observations.—This gentleman was an ardent sportsman, took excessive exercise, went through great exertion every morning, and in the afternoon rewarded his virtuous labours by eating, drinking, and sleeping—the fatigue of his sporting pleasures being previously sustained by an occasional draught of stout ale. He did me the favour of a visit, when I found, as he had stated, that he was in excellent health, but his size interfered with his plans,—"he could not get through the woods so easily as he used to do," and "it was not so easy as formerly to find a horse to carry him." "Now what do you recommend me to do?" "Keep your eyes open, and your mouth shut." "Poh! Nonsense! that won't do for me—give me *something to take*—have you no pills?" The same question has been so often repeated to some very able practitioners, that with Molière's doctor, they answer,—"Prenez des pillules, Prenez des pillules."

The pills this gentleman was in search of were to counteract the effects of a dose of strong ale, two gallons a day being his moderate allowance. As he was not only a merry fellow but a scholar, I gave him the opinion of an old poet on the subject of ale:—

-Nil spissius illa,
Dum bibitur, nil clarius dum mingitur, inde
Constat, quod multas fæces in corpore linquat.

He laughed, and replied with great good humour, "I see how it is—if I am *ale*-ing all day, it follows of course, I must be *ail*-ing all night. Egad! I can't help it, I should die without it, and I had rather die with it."

It is incredible the quantity of malt liquor that some men swallow, to the amount of many gallons. The Welsh are great

consumers of ale; and it is recorded of a Welsh 'squire, Wm. Lewis, who died in 1793, that he drank *eight gallons* of ale per diem, and weighed forty stone; which, for the reasons stated in the Latin verses, is not improbable.

This *Vinum Britannicum,* borrowed from the Egyptians, was originally patronised by the Welsh, and has subsequently been considered the natural beverage of Englishmen. I have known some honest Cambrians, who, like Boniface, "ate it and drank it," and would continue drinking it under constitutional derangements that would have killed an ordinary man.

"Nothing will stay on my stomach," said an old toper, "but beef-steaks and Hodgson's ale!—What do you think of my stomach, eh doctor?" "Why I think your stomach a very sensible stomach," was the equivocal reply.

CASE III.—*From a Country Practitioner.*

"I should before have replied to your letter of the 31st ult. had I not been waiting to see the person whose case I am about to give you; this I did yesterday, and, although the reduction is not so great as I had previously supposed, yet the particulars may not be irrelevant."

He then proceeds to give a long history, almost amounting to the birth, parentage, and education of a man five feet high—twenty-seven years of age—weighing twenty-three stone; and enters into a detail of his plans for reducing his bulk, the short abstract of which is, that

June 17, 1820, the weight of this person was, as stated,	23st.	2lbs.
July 27	21	10
Sept. 10	20	7
Oct. 10	19	3
Nov. 10	18	11
Dec. 10	18	4
,, 25	18	1

being a reduction of five stone one pound.

"I have always found it very difficult to get corpulent persons to give up those habits which lead to obesity; they are, for the most part, great lovers of the table, and not easily induced to forego the pleasures of it. On returning home, after some years' absence, I passed a man in the street without knowing him, although I had previously been well acquainted

with him. He had, from being as corpulent a person as I ever saw, become altogether as thin. Upon inquiring what disease had wrought this effect on him, I found he had been in perfect health, and continued so, but sheer poverty had laid its hand on him, and by depriving him of his usual good cheer, produced the change."

Observations.—There are many instances on record of persons being cured of obesity by accidental circumstances, very disagreeable in themselves, but very salutary in their results; and many very extraordinary cases are related in ancient authors bordering on the miraculous, but given with a confidence that should awaken our attention if they do not entirely overcome our incredulity. Of these, in Schenk's collection, is an account of Francis Pechi, a great sufferer from the accumulated mischiefs of good living, who was accidentally imprisoned. In the year 1556, after a lapse of twenty years, he was found by the French, who took the citadel he was confined in, to be alive and well, and, moreover, cured of all his complaints, and he walked through the city, with his sword by his side, without the aid of a stick. Dr. Berwick notices a similar case of his brother, who was confined in the Tower many years during the usurpation.

Tippoo Saib kept some English prisoners on bread and water. Notwithstanding this hard fare, on their release and return to Calcutta, they found themselves in better health, and some of them cured of liver complaints, while others of their more *fortunate* friends had died in the interim.

The anecdote told by Colley Cibber, of Romeo's Apothecary, and the case of the Brewer's Servant, mentioned in "Remarks on Corpulency," are of the same kind, and many cases similar to these must have occurred in the experience of every man who has lived long and much in the world.

Case IV.

A Gentleman called upon me one day, who, as soon as he entered, I felt myself involuntarily exclaiming, "Voilà, mon oncle! un petit homme haut de trois pieds et demi, extraordinairement gros, avec une tête enfoncée entre les deux épaules," —but more, he was the very epitome of good nature and good

living—the breathing personification of enjoyment—the moral type of merry-making. As soon as he could, he informed me that he was a Norfolk gentleman, (dumpling, he might have said,) passing through London to Devonshire for milder air, being troubled with "*shortness of breath.*" He did not call to consult me about that, but just to know if I had any *specific* to cure corpulency. Seeing that he was truly, according to Shakspeare's notion, "fat and scant of breath," I suggested Radcliffe's remedy; but he spurned such advice, he wanted the *specific.* I assured him I knew of none, when, with a look of good-humoured incredulity, he put into my hand the following notice:—

"*To the Corpulent.*—Nothing, it is universally admitted, can be more ungraceful and unsightly than a fat habit of body. It causes a man to look like a beef-eater, and gives to the whole person an air of extreme vulgarity. For this reason, a medical gentleman of the first eminence has, for a series of years, directed his study to the discovery of a remedy against this disagreeable complaint. Nor have his long and laborious researches been without success, insomuch that he has now the satisfaction of announcing to the public that he has discovered a certain specific, which will not only reduce the most corpulent person to a graceful and slender habit, but effectually prevent all those who take it from ever becoming fat, were they even to belong to the Court of Aldermen, or to be constant attendants at vestry-dinners. The proprietor pledges himself to the nobility and gentry, that his said remedy is so perfectly safe and harmless, that even a child at the breast may take it. To be had in bottles, only ten shillings each, duty included, at a *Fancy shop, Bare-bone passage.*"

Simplicity of character has been considered as a most amiable and enviable quality, and this man was the most striking personification of it I ever met with. We may presume it was the characteristic of his family, for he was seeking the *specific* by the advice of his *maiden sister!* who was "*counted*" *rather clever.*

The positive conviction that the whole was a joke seemed to disappoint him, for he expected that, with the specific in his pocket, he was to live *ad libitum;* and his worthy sister no

doubt intended to do wondrous works with such a powerful addition to her store of recipes.

CASE V.—*Extract of a Letter from a facetious medical Friend.*

"Our fat landlord's occupation is no more! he died suffocated by his own fat; and his disconsolate widow, who has been blessed with *four* doating husbands, is now in fine feather for another.

"Poor fellow! he wished to live, but he said 'the devil was in his stomach,' and truly a devil of a stomach he had. Preaching abstinence was in vain. His wife, worthy woman, knew his stomach as well as himself; she was constantly crying, 'he will die if he be not well nourished,' while he emphatically echoed, 'he knew his own inside.' So they cooked the matter between them, and a fine hash they made of it. He had no objection to physic; to do him justice, his stomach was more exigeant than nice, and when absolute necessity required the iron restraints of maigre, his kind wife always took care to slip a lump of butter and a glass of brandy into his gruel. But enough of the Red Lion.

"We have some jolly dames in this neighbourhood, tolerable specimens of what you call 'obesity,' but none of the dimensions of Park's African princesses, where no beauty aspires to royal observation without having first weighed down a moderate-sized camel.

"With respect to fat gentlemen, I beg to introduce myself—my height is five feet three inches, and I weigh seventeen stone, and I am ready to sit for my picture, in any attitude you think most favourable for giving full effect to my 'omental rotundity.'

"But to be serious,—have we not corpulency with little fat, and fat deposited several inches on the abdominal muscles, especially without distended viscera?

"Obesity, I conceive, may be a healthy or a diseased deposite; healthy, when a superabundant nutrition is taken up by the absorbent vessels, and when all the secretions of the body are perfectly performed; diseased, when a lethargic state of brain induces this accumulation, to the hinderance of muscular action, giving a bloated and plethoric character to the whole outline of the body.

"It is a healthy deposite in an animal feeding on grass, and rambling at large; it becomes a diseased one in animals tied to a rack and fed upon oil-cake; and it appears to me, too, that this disposition to sleep upon a distended stomach is the great promoter of the evil, as I am credibly informed by a gentleman in this neighbourhood, who formerly fattened bullocks, that all those animals who became restless and would not sleep, were invariably turned loose again as unprofitable subjects."

Case VI.

"At 30 years of age he weighed twenty-three stone, ate and drank with great freedom, and in great abundance, and was withal so lethargic, that he frequently fell asleep in the act of eating, and this in company.

"He felt much inconvenience and alarm from these symptoms, and went to Edinburgh to consult Dr. Gregory: in pursuance of his advice, he took a great deal of exercise, lived sparingly, and slept little. The quantum of the former depended on the season, and on the power of the patient to bear fatigue. The prescribed diet consisted principally of *brown bread* and tea, the former having a considerable quantity of bran; but as it was necessary to *fill* the stomach, the patient ate a great quantity of apples; and to enable him to take the necessary exercise, he found a pint of port or sherry a day indispensable. He retired to rest about eleven, and rose at four or five in the morning. The only medicine he took was three brisk cathartics a week. The precise time he continued under this rigorous system I have not ascertained; he is now thirty-eight, and has been well some years. He reduced himself to fifteen stone only, being a very large and bony man, and I understand that he now eats and drinks without any restraint, so much so, that it is thought he has of late got rather fatter, and may, without care, be again in the state from which he recovered."

Observations.—The memoranda of this case were given to me by a sensible friend, who, though an adept in the "savoir vivre," tempers good living with good discretion.

Under the judicious direction of Dr. Gregory, the patient was reduced *eight stone,* which is the most important fact in

the narrative. The next is the importance attached to brown bread, or bread having a certain quantity of bran in it,—a very grand secret in the history of *panification*, from its practical application to medical purposes, the whole of the alimentary secretions being altered by a change in the quality of the bread, as I know of my own experience, by occasionally dining with some of the advocates of this *bruno-nian* system.

To observe that just medium, with respect to quantity, which is most conducive to a healthy state of stomach, demands not only attention, but resolution. The *how much* must be determined by the individual; those who can abstain at the first sensation of satiety, and can resist the demands of appetite, have made great progress in the art of curing most chronic indispositions, of regaining health, and preserving it.

Unerring Nature learn to follow close,
For *quantum sufficit* is her just dose.

This, though a trite and familiar doctrine, cannot be too strongly or too often inculcated; in fact, "non satiari cibis" is a rule of health as old as Hippocrates.

Case VII.—*From a Country Physician.*

"Nothing proves you more to be a man of business than your nand-writing, which is as illegible as Sir Walter's. In this respect I am myself on a par with the most learned doctors of our acquaintance, as you will readily admit before you have read three lines of this journal. . . . . . Our fat patient fasts and grumbles, but keeps up his weight in a wonderful degree. ' C'est un personnage illustre dans son genre, et qui a porté le talent de se bien nourrir, jusqu'où il pouvait aller; il ne semble né que pour la digestion.' I believe he would fatten on sawdust. There is one very important improvement in his symptoms. He can breathe better, and can lie in a recumbent posture, which he has not been able to do for many years. This alone keeps him to his ' régime forte et dure,'—for it is a curious circumstance, that after three months' starvation, as he calls it, he is not above ten pounds lighter in weight, though he is wonderfully lighter in his feelings. Every time I see him I have to contend with some cogent reason, which he urges with considerable humour, to prove that his constitution will

suffer, all of which I have hitherto combated successfully. Yesterday, however, he took a new position:—he had doubts on a moral ground.—'It is a bad example,' said he, 'for

If all the world
Should, in a fit of temperance, feed on pulse,
Drink the clear stream, and nothing wear but frieze,
Th' All-giver would be unthanked.'

Observations.—The person alluded to in this letter, as might be supposed, died suddenly. He was a very sensible man, a perfect gentleman, a fine scholar, with a playful wit, that made him a most agreeable companion; and his temper was cast in that happy mould which "looks at everything on its most favourable side." The Doctor thought "he would fatten on sawdust," and truly, like Father Paul, "the little he took prospered with him." He grew fat in spite of starvation, which he enforced with some pertinacity, though he was constantly furnishing ingenious apologies for following the natural bent of his inclinations.* The most distressing symptom he had to contend with was difficulty of breathing. He constantly complained of oppression about the præcordium, and he had all the symptoms of hydrothorax. But having seen many cases with similar symptoms, where fat impeded the functions of life, I was always impressed with the notion, that it was fat and not water that oppressed the heart, and so it proved to be on examination.

I had an opportunity of examining the body, which presented one of the most extraordinary internal accumulations of adeps I ever witnessed. The heart itself was a mass of fat. The omentum was a thick fat apron. The whole of the intestinal canal was imbedded in fat, as if melted tallow had been poured into the cavity of the abdomen; and the diaphragm and the parietes of the abdomen must have been strained to the utmost extent of their bearing to have sustained the extreme and constant pressure of such a weighty mass.

* A humorous author has given an account of a person of this kind, a worthy woman, who kept adding growth unto growth, "giving a sum of more to that which had too much," till the result was worthy of a Smithfield premium. This was not the triumph of any systematic diet for the production of fat; on the contrary, she lived abstemiously, diluting her food with pickles, acids, and keeping frequent fasts in order to reduce her compass; but they were of no avail. Nature had planned an original tendency in her organization that was not to be overcome: she would have fatted on sour krout.

The mechanical obstruction to the functions of an organ essential to life were so great, that the wonder is, not that he should die, but that he should live. In very many cases of sudden death, charged to the account of apoplexy, I am perfectly convinced that the previous symptoms would be found, on inquiry, to be referrible to the heart and circulation, and the head has often been examined for causes which ought to have been sought for in the region of the hypogastrium. A sudden palpitation excited in the heart of a fat man has often proved as fatal as a bullet through the thorax; and that it was the cause of death here is most probable. There was no organ or viscus diseased, nor can even the immense deposition of fat in this case, as far as simple animal organization is concerned, be considered as disease.

There are many fatal diseases connected with the accumulation of fat about the heart, particularly angina pectoris.

In Dr. Blackall's cases of angina pectoris, we find, Case 3, "the heart large and fat;" Case 4, "a great deal of fat in the anterior mediastinum." The same occurs in Dr. Wall's case and Dr. Fothergill's in the Medical Observations and Inquiries. Also in a case by Mr. Paytherus.

Dr. Black, in a case of angina pectoris, in vol. vii. of Medico-Chirurgical Transactions, says, "the first striking appearance was the degree to which the cellular membrane was loaded with fat. The heart was loaded with fat." The same in the case of Mr. M'Cormick, ibid.; and the Doctor notices, p. 82, the relation to obesity.

Case VIII.

A worthy, fat, hypochondriacal bachelor sent for me one day to tell me that he was dying; that he had left directions I should open him for the benefit of mankind; and that, if it was important, it might be done immediately after the breath was out of his body, only taking care to pierce him through the heart to prevent resuscitation. This *scena* was repeated at least once a year for twenty years; at last he died, with as good viscera as any gentleman of seventy-nine years of age was ever blessed with. He was one of those who studied the art of self-tormenting, a comfort which, unfortunately for

those about him, he dispensed with a liberal hand. *Pity* seemed the pabulum of his life; and to exact commiseration for imaginary ills,

Which real ills, and they alone could cure,

was the great object of his existence. *He ate well, drank well, slept well:* but what of that? He had "weak stomach and giddy head; flying gout, wind in his veins, and water in his skin, with constant crackings and burnings." His business seemed, seeking for new causes to make himself miserable. "Your pulse is very good, Sir."—"Ay, so you say; everybody says so! that pulse will be the death of me; my pulse deceives everybody, and my complaints are neglected because I happen to have a good pulse!" "Your tongue, Sir, is clean." "Ay, there it is again; you should have seen it in the morning—as white as a sheet of paper."

The valetudinary, thus,
Rings o'er and o'er his hourly fuss.

Observations.—It is truly said that "*qui medicè vivit, misere vivit.*" There cannot be a more pitiable person than one who exists per force of physic, flannel, and barley water—drop their wine, weigh their meat, feel their pulse, examine their tongue, and make all their movements and meals by the regulation of the stop-watch. I know persons who, strange to say, are sufferers from the rigid regularity with which they eat, drink, and sleep. This is a city complaint, originally introduced by some of the Hamborough Van-Dams of the last century, whose movements resembled those of the figures of their own Dutch clocks, equally regular, and about as lively. These demi-Dutch invalids, who make the periods of eating, drinking, and sleeping the chief *business* of life, may be considered as *eating valetudinarians*, who never fail to put the very important question—"What am I to eat?" This constant query of invalids is very seldom satisfactorily answered. We remember Sir Richard Jebb's sad failure about muffins and boiled turnips. Dr. Reynolds, who was in every respect an able practitioner, was the most ready with his answer to this question. He invariably recollected whether it was muffins, or crumpets, or *boiled* turnips, or *baked* pears that he had recommended, and he never allowed one or the other of these *materia alimen-*

taria to be changed *without his positive order*,—and he was right, as will appear by the following anecdote:—

An eminent court-physician visiting a noble lady, the following scene took place: "Pray, doctor, do you think I might now venture on a slice of chicken and a single glass of madeira, as I feel very faint and low?" "Most certainly; I perceive nothing in the state of your ladyship's pulse, or the appearance of your tongue, to forbid so reasonable an indulgence." Her ladyship instantly rang the bell, and with more than usual peremptoriness of manner, desired the servant to order the doctor's carriage to the door immediately; then addressed him as follows: "Sir, there is your fee, and, depend upon it, it is the last you shall receive from me. I asked you a question, a serious question, Sir, to me, considering the very abstemious regimen to which I have so long submitted under your direction; and I think it full time to withdraw my confidence from a physician who delivers a professional opinion without any foundation: for you must be perfectly aware, Sir, that you neither felt my pulse nor examined my tongue."

Perhaps the most pertinent answer, after all, was that given by the celebrated Dr. Mandeville to the Earl of Macclesfield. "Doctor, is this wholesome?" "Does your lordship like it?" "Yes." "Does it agree with your lordship?" "Yes." "Why then it is wholesome." This was also the opinion of *Lord Bacon*, a tolerably good authority in matters of food, as well as philosophy. "There is a wisdom in this," says he, "beyond the rules of physic; a man's own observation what he finds good of, and what he finds hurt of, is the best physic to preserve health." So true is it, that a man, according to the trite maxim, is a fool or a physician at forty.

Mems. Relative to Diet.

The celebrated Dr. Franklin lived on bread and water for a fortnight, at the rate of ten pounds of bread per week, and was stout and hearty. But the most frugal system of house-keeping on record, was that of Roger Crabb, the Buckinghamshire Hermit, in the 17th century, who allowed himself three farthings a week.

A gentleman who had been a prisoner, and obliged to live

on a small quantity of barley, became so accustomed to eat very little, and very often, that he never sat down to regular meals, but carried biscuit and gingerbread nuts in his pocket, of which he ate from time to time.

Mr. ——, aged sixty, has for upwards of ten years only made one meal a day.

Sir John Pringle knew a lady, ninety years of age, who lived on the pure fat of meat.

Mossop, the actor, is said to have been particularly attached to various food, according to the line of character he was to represent. Broth for one; roast pork for tyrants; steaks for '*Measure for Measure*;' boiled mutton for lovers; pudding for Tancred, &c.

Dr. Gower of Chelmsford had a patient who lived for ten years on a pint of tea daily, now and then chewing half-a-dozen raisins and almonds, but not swallowing them. Once a month she ate a bit of bread the size of a nutmeg; but frequently abstaining from food for many weeks together.

Dined with Dr. C——, this day (Nov. 6th, 1802); he mentioned a case of a gentleman, who had never tasted fish, flesh, or fowl, but whose diet had constantly been bread and milk. He was once, in travelling, being very hungry, tempted to taste a small piece of chicken, but it had such an effect on him as to occasion fainting almost instantaneously.

Mrs. F., of Therfield in Hertfordshire, now a stout healthy woman, never tasted animal food till she was twenty years of age.

Brassavolus reports, of the younger daughter of Frederick, king of Naples, that she could not eat any kind of flesh, nor so much as taste of it; and as oft as she put any bit of it into her mouth, she was seized with a vehement syncopé, and falling to the earth, and rolling herself thereupon, would lamentably shriek out. This she would continue to do for the space of half an hour after she was returned to herself.—Turner's *History of Remarkable Providences*, 1697, fol. part 2, c. 2, § 6.

The late Duke of Portland broke a blood-vessel in his lungs when twenty-seven years of age. He was attended by Dr.

Warren, forty ounces of blood were taken from him in a few hours. He lived on bread and water for six weeks, at the end of which time, he was allowed *one boiled smelt.*

From this time he lived with the most rigid temperance, and never drank wine or malt liquor. He took a dram of powdered bark every morning in a glass of water, which, with a moderate breakfast, was all he was in the habit of taking, till a late dinner in the evening. In the early part of his life, he was confined to his room, three months at a time, with the gout. In the latter part of his life, though occasionally affected by it, it was never violent. His father was gouty, his mother not; his grandmother died of gout a little above forty years of age, 1803.

The monks of Monte Santo (Mount Athos) never taste animal food; they live on vegetables, olives, and cheese. In 1806, one of their fraternity was in good health at the great age of one hundred and twenty years.

HENRY WELBY died 1636.

Flesh he abhorred, and wine; he drank small beer—
Cow's milk, and water-gruel were his cheer.

OFFLEY.

Offley, three dishes had of daily roast,
An egg, an apple, and (the third) a toast.

Hasselquist, in his travels in the Levant, relates the following singular fact: "Above a thousand Abyssinians, who were destitute of provisions on a journey to Cairo, lived for two months on gum arabic; and arrived at Cairo, without any unusual sickness or mortality."

In Queen Elizabeth's time, the breakfast for "my lorde and my lady" consisted of "half a chyne of mutton, or ells a chyne of beef boiled;" and the children had "a chikynge, or ells three mutton bonys boiled, with certain quarts of beer and wine."

Mems. relative to Digestion.

Francis Bathalia, the stone-eater, *it is said,* converted his flinty food into sand in seven days.

Mr. — cannot digest an apple, it immediately causes pain in

the stomach, like a stone or any other hard body. He can, however, eat any quantity of toasted cheese.

Mr. — cannot masticate rice,—this simplest of all food he never eats,—and this is the reason he assigns for it.

Some have great power in digesting salted meats—ham, ba con, salted fish, are taken for breakfast in considerable quantity, without any inconvenience; these persons are never thirsty.

Sir James Earle and Dr. Robert Hallifax attended a child six years old, on whom scarlet strawberries constantly produced irritation in the urinary organs.

Opium and senna produce instantaneous effects upon the skin; oil of almonds does the same, and makes the face swell, as in erysipelas. Mr. H. of D. cannot eat almonds without having immediately a scarlet rash in his face.

The small black currant from Zante is rarely or ever digested by children, though they are constantly in their puddings and pies.

Mrs. B. cannot take milk without being instantly affected by it. Disguised in any manner, it never fails to manifest its effects.

New honey is obnoxious to many, and not unfrequently produces violent cholera.

Donatus knew a young gentleman who could not eat an egg without its causing his lips to swell, and bringing purple spots out on his face.

Idiosyncrasy.

Some men there are, love not a gaping pig;
Some, that are mad, if they behold a cat.—

So says Shakspeare; and it appears that the enemies of our nature work upon us, whether we are aware of them or not. In vain we demand a reason of ourselves for what we do or do not love.

That curious, sympathetic, wonder-working person, Sir Kenelm Digby, is, perhaps, the greatest detailer of singular fancies relating to antipathies and sympathies. He narrates the dire effects of flowers upon certain people, even to fainting and dying. So obnoxious was a rose to the Lady Heneage, that she had her cheek blistered, says Sir Kenelm, by laying a rose

upon it while she was asleep. It is even stated that Cardinal Caraffa and a noble Venetian, one of the Barbarage, were confined to their palaces during the rose season, for fear of their lives!

Johannes e Querceto, a Parisian, and secretary to Francis the First, king of France, was forced to stop his nostrils with bread when there were any apples at table; and so offensive was the smell of them to him, that if an apple had been held near his nose, he would fall a-bleeding. Such a peculiar and innate hatred to apples had the noble family of Fystates in Aquitain. *Schenck. Obs. Med.* l. vii. 890.

I saw a noble countess, saith Horstius, who (at the table of a count) tasted of some udder of beef, had her lips suddenly swelled thereby, who, observing that I took notice of it, told me that she had no dislike to that kind of dish, but as oft as she did eat of it she was troubled in this manner, the cause of which she was utterly ignorant of.

Bruverinus knew a girl sixteen years of age, who, up to that time, had lived entirely on milk, and could not bear the smell of bread, the smallest particle of which she would discover by the smell.

An antipathy to pork is very common. Shenckius tells us of one who would immediately swoon as often as a pig was set before him, even though it be inclosed in paste—he falls down as one that is dead, nor doth he return to himself till the pig is taken from the table.

Marshal Albret fainted away whenever he saw the head of a boar. Hereupon Bussi forms a sort of ludicrous case of conscience, whether a man who was to fight against the Marshal, should, in honour, be allowed to carry with him in his left hand the head of a boar. I have seen, says Montaigne, some run away at the smell of apples, as if a musket were presented at them; others frightened out of their wits at a mouse, and others not able to abide the sight of cream, or the stirring of a featherbed, without something very unseemly happening to them.

The mildest medicines create in some as great disturbance as if they were the most violent. Manna and senna are dread-

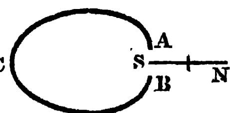
fully distressing to some persons. One grain of calomel has been known to produce a salivation of weeks, and to produce an instantaneous eruption. Opium frequently produces violent irritation of the skin, and many judicious physicians never prescribe it to strangers, without inquiring whether they have ever taken it before, and with what effect. Fallopius mentions an abbess of Pisa, to whom he often prescribed pills, who never swallowed them, but crushed them flat with her fingers, which speedily produced an effect.

The odour from ipecacuanha has produced very violent effects. A lady's maid putting her lady's cap into a wardrobe, became instantly affected with nausea. No notice was taken of it, it was considered as accidental. A few days afterwards, going to the same wardrobe for the cap, she was again seized with nausea and sickness. She then said she was sure there must be ipecacuanha there, and so it turned out,—for my lady's husband had bought a box of ipecacuanha lozenges, and had unconsciously left them in the wardrobe.

Experiments on Heated Iron, in reference to the Magnetic and Electric Fluids.—By WILLIAM RITCHIE, A.M., Rector of the Royal Academy at Tain.

(Communicated by the Author.)

IN repeating some of the interesting experiments of Professor Barlow on the magnetism of heated iron, I was led to some curious results, which, as far as I remember, have not been previously observed. The magnetic needle I employed, consisted of a piece of steel wire suspended by a single fibre of silk, and thus preserved extreme delicacy. I bent a piece of stout iron wire into the shape ACB, having the portions at AB exactly equal, so that the point of the needle S, could be acted on with the same forces when the wire was cold.



Experiment 1. Raise two or three inches of B to a white heat, bring AB equally distant from S, and the needle will be drawn towards A. When B has sunk to a red heat, the needle

will be more forcibly attracted towards B, agreeably to the experiments of Professor Barlow.

Experiment 2. Raise B to a white heat, apply the north end of a pretty strong magnet to C, and the needle will be drawn forcibly towards A. When the part B has sunk to a red heat, the point B will become a stronger north pole than A, and the needle will be forcibly drawn towards B.

Experiment 3. Raise B to a white heat, as before, apply the south end of the magnet to C, and the needle will be forcibly *repelled* by A. When B cools to a red heat, it will now become a stronger south pole than A, and the needle will of course be repelled from B.

It is obvious from the two last experiments, that iron heated to whiteness prevents, in a great measure, the decomposition of the magnetic fluid from C to the remote end of the wire at B; but when raised to a red heat, the decomposition goes on more readily from C to B than it does at the ordinary temperature of the atmosphere. I was now anxious to try whether iron heated to different degrees had similar relations with regard to the electric fluid. To ascertain this, I had recourse to the following experiments:

Experiment 4. I heated the knob of an iron poker white hot, and fixed the other end in the prime conductor of a powerful electric machine, and found that I could not, with a smooth brass ball, draw a single spark from the heated knob. When it began to assume a red heat, a rapid succession of small sparks passed between the two balls; and the sparks gradually struck off at greater intervals and increased in size as the iron cooled.

I was now about to draw the conclusion, that iron, heated to whiteness, was a very imperfect conductor of the magnetic and electric fluids, when this striking relation, which I fancied to exist, was proved, by the following experiment, to be quite imaginary.

Experiment 5. I brought the middle of the poker to a white heat, and having placed it in the conductor, found that I could now draw sparks from the cold knob exactly as if the whole had been at the ordinary temperature of the air. It was cu-

rious to observe the effects produced by moving the knob along the whole length of the poker. The sparks were strong at the cold knob, diminished in size towards the middle, when they entirely ceased, and again increased in size towards the conductor.

I endeavoured, in vain, to discover the cause of this striking difference between the hot and cold iron, when I found I was searching for the cause of an effect which did not take place, as the electric fluid was silently drawn away by the smooth ball, exactly as if it had been a sharp point. This is clearly proved by the following experiments:

Experiment 6. Hold a fine polished brass ball opposite the part of the poker brought to a white heat, and not a single spark can be taken from the cold knob, though the electric fluid do not pass in sparks from the heated portion to the brass ball.

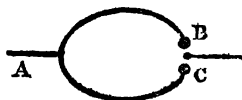
Experiment 7. Raise the knob of the poker to a white heat, and it will silently draw off the electric fluid from the prime conductor without the appearance of a single spark. As the ball cools, sparks begin to strike off in rapid succession, as before. The same effects will take place when the experiments are performed with reference to the negative conductor.

Experiment 8. Charge a Leyden jar, heat the knob of the poker to a whiteness, and use it as a discharging rod, and a strong spark will strike off between the knob of the jar and the heated end of the poker, exactly as if it were cold.

From this experiment it appears that, when the tension of the electric fluid is very great, the striking effects of heat in the preceding experiments, entirely disappear.

I was now anxious to try by more accurate experiments whether there existed any difference in the conducting powers of cold iron, and iron raised to a white heat. This I accomplished by the following experiment:

Experiment 9. I made a conductor of strong iron wire in the form of BAC, having two brass balls at BC. I then raised a few inches of the rod between A and C to a white heat, fixed it in the conductor, and applied a small brass knob between B and



C, till the fluid struck off to the knob equally from B and C. I then allowed it to cool, and on turning the machine, the fluid struck off to both exactly as before. I have thus been unable to detect the smallest difference between the conducting power of cold iron and of iron raised to a white heat:—a result very different from what I at first anticipated.

Modern Improvements in Horticulture.

(Continued from page 275.)

The Flower or Botanic Garden.

There is no country seat complete, unless some portion of the grounds be set apart for a flower-garden or pleasure ground. It usually occupies a space near the house, and may be seen from some of the principal windows, but so as not to intercept the view of, or exclude any interesting distant scenery. It is the associating link which connects the high style of artificial decoration of the interior and exterior of the mansion with the natural features of the park. It is laid out in a style, which unites every comfort of walking or reposing, with every trait of beauty, tranquillity, smoothness, and softness; the freshest verdure, the choicest flowers, the gayest colours, the most elegant forms, the most graceful trees, and most ornamental and odorous shrubs, here find a place; and every plant, whether tree, shrub, or herb, is always here in the greatet perfection.

Evergreens generally prevail, to cheer the dreary face of winter; and in some convenient spot are placed stoves for the reception and cultivation of exotics of the torrid zone; greenhouses for the preservation of all beautiful potted plants of the warmer parts of the two temperate zones; and a conservatory for the larger growths (or to allow the larger growth) of tree-like plants from all climes, in which they are planted in the ground, in suitable prepared soil. This last-mentioned building is certainly a superior and most eligible receptacle for plants; the ample space allowed for the roots, stem, and branches, admits of their more free expansion of growth and form, and of the flowers and foliage; and also

to arrive at that magnitude which must precede fructification. Such edifices (with a few exceptions, as the old conservatory at Muswell Hill, built in the time of George II., by Beauclerc, better known as an astronomer than a botanist) are now coming into fashion; and from the facility afforded by curvilinear or rectilinear metal-framing, added to the practicability of adopting the highest architectural embellishment in the construction, such buildings may not only be the most ornamental in our gardens, but also the most elegant examples of our national architectural taste. In fact, whenever the amateur prefers a choice collection of perfect beauties, to a confused melange of imperfect individuals, such a building, with what it may contain, will unquestionably yield the greatest share of botanical gratification. They also supersede the old disagreeable orangeries formerly thought a necessary appendage to a palace; and when erected in a range, they may not only partake of a highly ornamental exterior, but interiorly be fitted up for the various purposes requisite for the different groups of the collection.

Aquariums.—These are receptacles for water plants in our flower-gardens, either within or out of doors; they are necessary in every botanical collection, as some of our most splendid flowers are aquatics. These tubs, cisterns, or basins, are not brought to that perfection they may be, because some water plants delight only in running, or at least a frequent change of water; but with the hydraulic powers we now possess, everything in this way may be accomplished, and suited to circumstances both of place and object.

Rock Work—Is a new feature in our gardens. Lucky is the proprietor who can extend the quarter of his flower or botanic garden into a rocky dell; then, all the vegetable beauties which inhabit the craggy cliffs, the mossy cave, or humid grot, would be at home: but rock imitated on the soft and beautiful face of a flower-garden, is not consistent taste; but by changing the high and harsh-sounding name into *Alpine plant borders,* and occupying some shady and secluded corner, it is admissible; because it may there form an unobtrusive and proper receptacle for the plants which cover it, and pretend to no further character.

We have now finished our view of the rise, progress, and present state of British gardening; it remains to look forward to what may be the probable consequences of a continued application of our present means, powers and knowledge, (assisted by the popular feeling) in accomplishing further improvements. The practice of gardening may be advanced by individual and united exertions. Experimental and comparative practice is the proper province of Societies, results which require extensive operations and information should only be attempted by them; and as they form a nucleus to attract and receive new facts and discoveries, which are ever floating down the current of practice, theirs is the task of seizing and recording those fugitive casualties, which might otherwise be lost. From combination of talent, much highly beneficial intelligence and valuable instruction may be, as has already been, derived; and as their Transactions are published, the end of their association is answered.

But much may be obtained from the private and lonely efforts of individuals, who, to a love of their profession, add the laudable emulation and justifiable ambition of excelling in their business, for their own satisfaction, their employers, or the public good. Let such, each in their quiet and perhaps humble sphere, be still pressing forward into the field of experimental improvement, and divesting themselves of previously acquired rules, which may have degenerated into prejudices, and which their own modesty, perhaps, or deference to the dictum of a parent or master, have riveted: let such only think and act for themselves, and no doubt better practice and useful consequences will be the result.

Periodical publications too, which admit communications, reports, queries, and answers, on the art of gardening, are eminently instrumental in embodying and circulating horticultural intelligence; and thereby forming a kind of intellectual bond for the whole fraternity.

To all these sources of future improvement it will only be necessary to muster a few of the more prominent bars which obstruct us in our march to success, and which operate to defeat our best laid schemes and most careful endeavours to secure what we wish to obtain; and first, those of the—

Climate.—To protect plants from the cold of winter is so habitual to the British gardener, that there is no room for additional circumspection on this score; that defence should be complete, is evident; all buildings for this purpose should in their construction admit of every degree of heat artificially applied, which in extreme cases may be necessary. A house-frame, or mat covering, should be equally capable of repelling frost at zero of the thermometer, as it is when only at the thirty-second degree; many houses are imperfect in this respect, and, owing to badly constructed flues, or want of sufficient fire-places, the crops or plants are lost, or placed in jeopardy. It has often occurred to the writer, that admitting supplies of air from wells and other deep excavations in the earth, would be a cheap and effectual security against the hardest degree of frost;* and even in summer, admitting the temperate and moist air from such subterranean cavities, would be far more suitable and refreshing to plants than the highly desiccating air, under the influence of a noon-day sun: for who, acquainted with what happens in a hot-house in a hot day, but must wish at the time he could mitigate the parching effects of the united direct rays of the sun, and the reflected and accumulated heat from the glass and form of the house? This is only counteracted by copious waterings within the house, and by shading:—the first, from increased evaporation, generates cold, or (properly speaking) a lower degree of heat, (but which *increases* the heat *because it is first raised as steam*,) so that from this union of extreme heat and humidity, the plants are, for a time, actually stewed! and, though apparently refreshed, it is a degree of excitement which they should be but seldom subjected to. Thus it is obvious that the light and heat of the sun must be guarded against as well as the consequences of too low a temperature of heat; and that means for shading plants in our system of forcing in summer are as necessary as defending them from the rigour of winter.

Soils.—The surface of the earth is composed of different qualities, more or less suitable to all vegetable products: as sand, clay, bog, or gravel, and of these there are numberless

* Such subterranean chambers would be found highly useful or many purposes of gardening, beside that of supplying warm air.

combinations and varieties, from the mouldering rock down to the alluvial deposite of yesterday. The best for all purposes of a garden is that combination of sand and clay which is called hazel loam, of such consistence as not to be adhesive by any action or weather, and yet so compact as to form a bed or basis of sufficient solidity for plants, of adequate depth for the nature of every kind of root; pervious to, yet not retentive of water, whether from the clouds or springs; and reposing on a substratum of stone or gravel. Such soils are generally alluvial, and contain the best qualities of all others, without their defects. Soils of very different character may, nevertheless, be successfully used for a garden, skill and labour overcoming many natural obstacles; and it is always observed, that a new garden, whatever the natural soil may be, is peculiarly suitable for fruit-trees, and almost all other productions first cultivated thereon; so true is it, that maiden, or untried earth, contains that genial vegetable pabulum so conducive to their health and fertility, and which in time becomes exhausted. On this fact are founded all our best established rules for alternations of crops, change of seed, &c. Even individual trees, which are gradually sinking by decay on an old station, will receive new life if transplanted to another, especially if carried to some distance; so that even the local atmosphere, *it seems*, as well as fresh soil, is favourable to renew vegetable vigour; and old gardens, or worn-out soils, can only be continued productive by frequent supplies of fresh earth or manures, and occasional changes of trees and crops.

Decayed vegetable substances are the only suitable habitat for several kinds of plants, and are an excellent manure for all; and united with animal and some mineral substances, form the chief material of composts and manures. Soils and plants may be improved and assisted by liquid manures on many occasions and in various circumstances, which do not always occur to the cultivator, but which he should always avail himself of when the ordinary means are impracticable.

Aspect and Situation.—A south, or rather two points to the eastward of south, is the exposure which has been chosen as most eligible for the site of a garden, for two reasons; the first, for receiving a larger share of the sun's rays, and less of

the direct force of the north winds; the second, because the quality of land declivious towards the east, is generally superior to that on any other direction; and, in these northern latitudes, our earliest productions are checked and retarded by our long, cold nights; the sooner the sun's influence is received in the morning, therefore, the greater is the advantage; and though his influence is sooner lost in the afternoon, this is considered a convenience, after the heat of a warm, clear day; and even in the moderate weather of the spring months, it prepares the plants for any extreme cold which may happen in the following night. Some practical men there are, who rather prefer an aspect two points to the westward of south, because the garden would be less exposed to east winds, which are equally noxious with those from the north, and because the walls would receive a greater share of the afternoon sun, to act as a defence to the trees, during the cold of the ensuing night. With regard to situation, there are most palpable errors committed in confounding the ideas of shelter and warmth, two very different things; and, however necessary it be, that a garden should be sheltered from violent winds, it does not follow that such spot should also be the warmest: in fact, we often find the contrary to be the case, it all depending on the dampness or dryness of the soil. A low degree of heat is always generated in proportion to the quantity of evaporation; consequently the damp and most sheltered valley, or the swampy hollow on a hill, are invariably found colder, and, consequently, more liable to the hurtful effects of frost, than the more elevated and drier knolls of the surface; and not only from the intensity of the cold, but from the susceptibility of the plants in such places, respectively. Thus then experience would advise that an elevation of not less than 55 feet above the level of any swamp or river, is found to be, throughout two-thirds of our seasons, far more favourable to vegetation in gardens, than lower situations, however sheltered they may be. But if a peculiarly dry spot can be found in a valley, and especially if it be intersected by a *tide river**, and though but little elevated above, it should

* The impulses of a tide river on the atmosphere are always found to moderate the cold of winter; and as such places have also the cold-repelling effects of crowded population and sea breezes, vegetation is less liable to suffer from frost, notwithstanding the air may be more humid than that on the hills at a distance.

be preferred, because, in such case, shelter and warmth would or could be united; and from this it is evident, that the drier the atmosphere, the drier will be the plants which are in it, and consequently better able to resist refrigeration.

There is a modern discovery, and means practised for the preservation of fruit-trees from the effects of frost. The immersion of frost-bitten extremities of the human frame to neutralize its fatal effects, was the circumstance which suggested the idea. This was first found useful in recovering frosted potatoes, &c., but is now applied to wall-fruit trees, even when covered with flowers, or their hardly-formed fruit; and while the trees are encrusted with ice, they are washed with water from the engine to free them from it before the sun comes upon them, which would otherwise be fatal*. But the best preventive of frost from injuring wall-trees is the plan of covering the wall with coping, which projects five or six inches over the trees, and which prevents the perpendicular descent of cold, or rather the right ascension of heat, thus rendering early washing unnecessary.

It has already been hinted, that plants seem to require, at least to take nocturnal repose; there is also a diurnal repose observable among plants, and visible by the collapsing of the flowers, on or before a temporary obscuration of the sun's light; hence the provincial name of the pimpernel, "go to bed at noon," or the shepherd's weather-glass: because, when the stimulating agents, heat or light, are withdrawn, the positions of the leaves of plants and petals of their flowers are altered, a certain flaccidity, especially of the foot-stalk of the leaves, is seen, and nearly in the same way as when a due supply of water at the roots is wanting: so plants which are not natives of the torrid zone require a temporary or winter's rest. Now, in our system of forcing, we change the natural seasons of our plants, and, by furnishing them with an artificial spring, sum-

* Why do the direct rays of the sun injure frozen plants, and why, if the frost be washed off by water, is the fatal effect of frost avoided?

The reason seems to be this:—water dissolves and withdraws the crystallization *gradually*, and without producing in the solution a greater degree of cold, whereas the sun's rays produce a *rapid solution*, and consequently a more intense degree of cold, which is the destructive agent.

mer, and autumn, their constitutional winter arrives before our natural summer is over, therefore they should have an artificial winter also provided for them. This we can only do for portable plants, by removing them to a north and shady border, and with others that are stationary we can only expose them as much as possible to the coldest air, and screen them from all excitements of either heat or light.

Plants, by unseasonable treatment, accommodate themselves to the change: thus, if a potted vine be taken out of the house at Midsummer, and pruned in September, it will bear forcing earlier, or will, of itself, shoot earlier than another kept in the house later, and not pruned till November; and, if this be continued annually, the plant may be brought to a complete reverse of season, if all other circumstances of light and heat be supplied; similar in all respects to the vines and other northern plants cultivated at the Cape of Good Hope, or any other part of the southern hemisphere.

Next to the severity of the winter's cold and summer's heat, the attacks of insects are the most formidable. They are a great army, with which the gardener must be ever at war. The enumeration and description of all that infest our gardens would take up too much of this paper, I shall therefore only mention a few of the most destructive and best known, *viz.:*

Aphides.—This is a most, if not the most numerous class of insects in this country. There are several species of them; but, as they receive their colour from the quality of the plant on which they feed, naturalists have made many more species than there really are. On beans and alder they are called blacks; on pease, shrimps; on hops they are called lice; and on roses, vines, and peach-trees they are called "the green fly." In spring and summer they are viviparous; in autumn oviparous: are produced by animalcular generation, hence prodigiously prolific; the males, and some generations of females, winged, so that they spread over the face of the country in dry seasons with astonishing rapidity. Their food seems to be a saccharine extract from the plant, as their excrement is the honey-dew, of which, in some seasons, the greater part of the sweet store of our apiaries is composed:—hence may be identified the plants

which yield or contain the greatest share of sugar, and which is indicated by the quantity of honey-dew on their leaves: from the lime and maple trees it sometimes even drops from the points of the leaves to the ground! The aphis are the natural prey of many other insects, particularly the beetle tribe, as well as of the soft-billed birds (Motacilla), and are constantly attended by ants, flies, and wasps collecting their sweets. They injure and deform the leaves and tender shoots of plants, so as sometimes to kill them entirely. They are easily killed and extirpated by any acrid fumigation, particularly that of tobacco: water impregnated with lime, or soft soap, is also recommended as an aphidefuge.

The Red Spider.—This is a very minute species of Acarus: there are two or three species found on plants; the most common one is that which infests peach-houses, vineries, plants kept in them, and wall-trees generally. A solution of soft soap in water, and frequent and forcible waterings from a syringe or engine, keep them in check.

The Coccus Lanigera, or woolly American Blight, is an imported injurious insect. It is said it was first introduced from France by a Mr. Swinton, brother of the late Lord of Session Swinton, in Scotland: he was a lieutenant in the royal navy, and, marrying a French lady, settled at No. 6, Sloane Street, Chelsea, where he established a Foreign Nursery, and published a French Newspaper. That this gentleman introduced the insect to the neighbourhood of London is probable, as his collection of apples, in 1790, was sadly overrun with it; but it must have been in England long before that time, because it was common on crabs, and even thorns, in the wild copses of Buckinghamshire in 1795. It is not generally known that there are two species of coccus frequent in our hedges and underwoods, designated ovate and reneform; they are both found on the smooth bark of young ash-poles or trees, and sometimes on the red willow. Both species may be collected, and they appear to yield the dyeing matter of as deep a tint as that from the cactus cochinillifer. Washes of lime water, laid on with a strong brush in winter and early spring, are destructive to them; and soft soap and water is also useful in the spring, because its glutinous consistence prevents their migra-

tion, and it may be otherwise offensive to them. They are imperceptible to the naked eye when very young, and it appears they can even insinuate themselves under the bark: before they bring forth their young they become stationary, and construct for themselves nurseries for that purpose, composed of some exuviæ from their bodies, which are formed into a brown hemispherical shell, as on orange trees, pines, ash, &c., or into an efflorescent fibrous covering, (hence lanigera,) as on apple, larch, and Weymouth pine, &c.

Caterpillars.—The larvæ of butterflies, moths, beetles, and innumerable flies, infest and devour the leaves, flowers, and fruit of vegetables, requiring the unceasing vigilance of the gardener. The snail tribe are also a voracious pest, and being oviparous hermaphrodites, increase very fast, delight in damp places and damp weather. Salt or powdered quick-lime kills and disperses them.

The disfiguring effect of insects upon trees is generally called blight, and is by some naturalists attributed to certain noxious qualities of the air or winds, but it is perhaps more rational to conclude that inherent disease and insects are the most prevalent causes. That the leaves and tender shoots of plants are often damaged by frosty, accidental, noxious, or parching air, is too often seen, and such effects are properly called blight; but the depredations of insects are quite another thing, and therefore should not be confounded therewith, lest the idea may throw the gardener off his guard by passively suffering under what is conceived to be an atmospherical, and therefore an irresistible agent, instead of inspecting, detecting, and driving the lurking and tangible enemy from their hold.

Almost every gardener is acquainted with some means or other of getting rid of insects as soon as their depredations are visible, but the desideratum is, the *prevention* of their attacks rather than the cure of them; this should be the cultivator's object. For this purpose he should be acquainted with the economy of the insects, so as to be able to ascertain or guess where and how they subsist through the winter; how they in their egg state may be vulnerable to liquid or pulverised applications. Many, and perhaps simple compositions may effect this, if only applied from a watering pot or puff, before, or at

the time of the opening of the buds, and with perfect safety to the plants. Such a discovery would be most valuable, and if extended to espalier and standard trees of all kinds, as well as houses and walls, many valuable crops of fruit might be secured and many a sickly tree (the first to suffer from insects) be preserved. In our search for ingredients* to compose such a protection for our plants as would either offend or destroy the spoilers, we are often led astray by supposing that such qualities as are disagreeable to our own palates, must also be so to the insects; but this may be quite the reverse, as many of our most gratifying condiments may to them be both offensive and fatal. We have, therefore, a vast store of qualities, from which we may obtain some one, or a combination, that would answer our purpose.

The crops of the kitchen garden, particularly the cabbage tribe, are preyed on by caterpillars of many kinds; those of four or five sorts of moths and three or four different butterflies. The turnip-fly, a species of beetle, (crysomela nemorum vel oleracea,) is destructive to many young seedling plants, as well as annual flowers; and as many of them are attracted to the plants which their larvæ devour, chiefly by the odour, a wash may be employed for the preservation of particular crops, which may drive the insects from their prey.

Of the Diseases of Plants.—Some of these are radical, and are owing to the unfavourable constitution or deleterious qualities of the soil; in which case a change of it for that which is better, is the only remedy;—sometimes from accidents which cause early decay;—in some cases from the non-assimilation of the stock of a fruit-tree with its bud or graft;—sometimes from natural decay, from attacks of insects, and from parasite plants, as mildew. The last is a fungus or agaric, which infests the straw of cereal plants, (but on them is not white, but black or brown, hence its other name, rubigo or rust,) the leaves of the berberry and some others: but the most destructive fungus is that which is called mildew, from its milky or meal-like appearance. Fruit-trees, especially peach and

* There are some plants which are rarely preyed on by insects, such as the tomatos, artichoke, &c.: the repulsive qualities of such plants should be ascertained, and perhaps decoctions or other extracts from such might act as repellents.

nectarines, are very subject to this disease, appearing on the tender shoots and leaves, which, if not removed, it eventually destroys. Sometimes it seats itself in spots on the fruit of peaches, and on the leaves of apricots and pears. It yields to and is destroyed by two or three applications of strong soap lather. Which quality in the soap effects the cure, is perhaps not yet ascertained, whether it be the alkali or grease, or both together, is worth knowing; because, if the alkali be the agent, water impregnated with that quality may be easily had, and as it is easily distributed as a wash, it may be generally useful for many kinds of plants liable to the disease. And here it may be observed, that practical gardening may be greatly assisted by a knowledge of chemistry; indeed, were it possible to unite the knowledge of botanical physiology, with the powers and science of chemistry, and to add to these the acumen of practical gardening, an oracle would be embodied whose decrees would be a lantern to the feet of the practitioner, arm him with new powers of defence, and show him the safe and certain road to success. For there can be no doubt, that by the union of those powers, many discoveries might be made, many general as well as particular rules laid down, which, as auxiliaries, would strengthen the hands of practice in the prosecution of the desired end.

These observations are thrown out to the notice of practical men, to show that the range of exertion is extensive, that all means, whether immediate or remote, at hand or afar off, should and may be employed in the pursuit of their business.

Late crops of peas are particularly liable to be destroyed by mildew. The President of the Horticultural Society attributes this to a want of sufficient moisture at the roots, and declares that copious watering in autumn, is a preventive. Is this the cause of the decrease in peach-houses, and on open walls also?

In our present improved system of kitchen-gardening, there hardly appears room for any amendment; we seem to have arrived at the 'ne plus ultra' of the art: but this idea should not prevail, because there may still be openings for advancement: wherever there is an interruption in the supply of the same kind of vegetable, (as in the case of the summer and autumn supply of cauliflower for instance,) the interstice

should be filled up; and so with other vegetables. Shifting the time of sowing, may sometimes be beneficial, especially as worms or insects may prey on a plant at one season, which they will not do at another. Magnitude, if it be required, or qualities of vegetables, may be improved by various expedients; potting young plants, in which they may be defended or forwarded on frames or houses, (as is practicable with many sorts of culinary vegetables,) should always be pursued for the sake of either early or seasonable products. In short, as long as successful gardening depends on soils, situations, and seasons, so long must particular rules be occasionally applied or laid aside; and he, who can rationally divest himself of precedents, will be the most likely to advance the practice and improve the products of his business.

Training trees on walls, espalier-rails, trellisses, and in particular forms as standards, is a most important part of the gardener's duty. In northern climates, it has been long the principal expedient for procuring a greater degree of heat by reflection, for security from winds, facility of protection by coverings of nets, bunting, mats, branchlets of evergreen trees, &c. This compulsory and unnatural form of growth on a plane, instead of the orbicular or conical, has led to different styles of training, namely, the fan, *fig. a.*, the horizontal *fig. b.*,

fig. a.

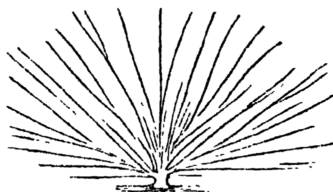
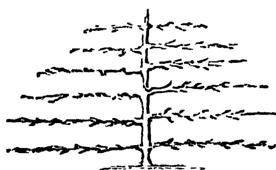


fig. b.



the pendent, *fig. c.*, the irregular, *fig. d.*, and various modi-

fig. c.

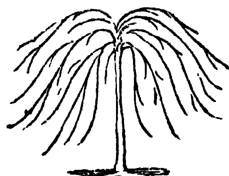


fig. d.



fications of all these—all which, either promote or check the natural luxuriance of the tree; and accordingly the kind of fruit, or mode of bearing, fixes, or ought to fix, the form which should be adopted. Sometimes perfect symmetry may be united with fruitfulness; as the fan form for peach, nectarine, and morella cherries; the horizontal style for pears; and the irregular for apricots, plums, mulberries, apples, and spur-bearing cherries; and with vines and figs, upright stems, horizontal branches, and pendent shoots will be found, under he pruning and training of a skilful hand, the most successful. Skill is everything in this process, as no particular rule can equally apply in all cases. Too much knife only increases the demand for its use; and, therefore, symmetry should always give way to the object for which the tree is planted; because, we impose a form and a confined space to a tree which is constantly endeavouring to fly from it, and, therefore, the expert trainer will exhaust the exuberance of the tree by compelling it to take such a form, and thereby divert the current of the fluid into unnatural directions, so as to moderate its rampant flow, and consequently turn that to fructification, which would otherwise be wasted in sterile and disorderly luxuriance*.

The open garden is divided into compartments for the sake of regular cultivation; for this purpose, walls are unsightly—hedges are equally so, and unprofitable; a fruit-bearing paling, or espalier as the French call it, is in all respects proper. On these, the hardier kinds of fruit-trees are trained, in several ways, though the horizontal is the most convenient. Some proprietors, disliking this unnatural form, prefer planting in the same place without rails, and allowing the trees to form their own head; and by imposing such checks on the growth, as will dispose them to a moderate magnitude, they present, when covered with fruit, a most gratifying spectacle.

* Regular and neatly trained trees are a material object of almost every gardener's attention. It is a mark of practical precision, and gives an appearance of methodical order to the garden; admitting this, too much should not be sacrificed to right lines and symmetry. Trees which have been the victims of this custom, often become unsightly and unprofitable, by losing their bearing wood near the stem; but the careful practitioner obviates this, by timely insertions of grafts or buds, in the vacant places; than which, there is not a more judicious and useful improvement in arboriculture.

Other forms are also chosen for convenience, such as the cylindrical, with the branches trained spirally round, *fig. e*, pyramidal, *fig. f*, umbrella, *fig. g*; these last-mentioned forms

fig. e.

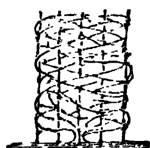


fig. f.

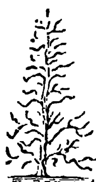
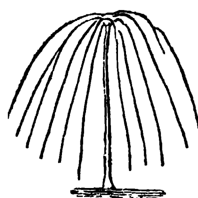


fig. g.



are generally adapted to the pear or plum, and are much practised in France. Corridor and arbour training is also performed with the vine, but, except in particularly warm and dry situations, the fruit seldom ripens.

A lately invented trellis has been adapted to vineries in Scotland, which has merit; they are called pendent trellisses, because they are attached to, and hang from the rafters of the building; they are composed of a slight frame of laths or wire, of the same width of the rafter, the exterior sides of it forming an extended surface, on which the vines are trained; the lower edge is curvilinear, giving head room at back and front. (LOUDON'S *Gardeners' Magazine*).

Mr. John Long, builder, Chelsea, has invented a moveable trellis for vines; it is fixed with hinges at bottom, and can be elevated or lowered by pullies, according as the weather may render necessary, or the management of the trees require. Both those schemes are improvements, and serve to show the resources of a fertile mind when once induced to leave the beaten track of rules and reigning fashion.

Acclimating the valuable fruits and forest trees of warmer climates is a point of the utmost national importance, and ought to engage the attention of every man employed in gardening. It is known, and we have several instances of the fact, that the constitutions of plants may be altered by cultivation. The qualities which render plants obnoxious to frost, are the aqueous nature of their sap, which renders it easier of congelation, and the fragility or want of toughness, or elasticity of the fibre, which allows the laceration and destruction of the vessels. Plants seem, therefore, fitted to their respective

natural climates, by a difference in the consistence of their sap, elasticity of their fibrous structure, or by that particular state of growth, in which they are when assailed by the frost.

Plants having a resinous, gummous, or inspissated sap, (the state of that of almost all our deciduous trees during winter,) seldom suffer from frost; but those whose growth is caused by the fluidity of their juice, or when it happens to be so, either from its nature, or warmth of the air, and of whatever climate they may be natives, they invariably suffer. The process of hardening plants is by moving them gradually, and perhaps at first only annually, from a warmer to a colder place, to prepare them for the winter's frost, by keeping them as dry as possible, and out of the sun's rays*, by giving them the driest soil and situation during the cold months, and by reducing the coverings (if coverings have been first used), till they can be entirely left off. Seeds, grafts, or cuttings from these, will, it is likely, be hardier than the parent; so that in course of a few years, a progeny may be reared able to bear our severest winters.

A project for obtaining an increased degree of the sun's heat has lately been practised, which may be mentioned: dark colours absorb more of the sun's heat than others, therefore, fruit walls have been painted, or rather stained with a black colour, by which their heat is raised an extra ten degrees, which is a material advantage if it could be had when most wanted; and if only when frosty nights may be expected it could be so arrested as to resist the fatal chills of the night air, then it would be a valuable protection. But it has been observed by a gentleman† well skilled in meteorology, that the extra heat gained in the day will be all radiated off before the return of morning; in which case, the additional excitement of the day will only subject the trees to a more severe assault from the frost of night. Those who have tried the plan, however, speak favourably of its effects, and especially as it kills the eggs and frees the wall from insects.

We have now gone over the subject as proposed, have taken a hasty view of the early history of gardening, the gradual introduction and improvement of it in Britain, together with a

* Because, if the youngest shoots have been sufficiently ripened previously, the sun's heat in the autumn tends to liquefy the sap, and renders plants more susceptible of injury from frost.

† J. F. Daniel, Esq.

general view of its present state and probable advancement in future, noticing some of the objects of supplementary improvement, with hints for compassing them. It only remains to conclude with a brief summary of how far the art of horticulture has benefited mankind, in past and at the present time, and how far it contributes to both public and private happiness.

The general face and aspect of the country is enlivened and enriched by the efforts of gardening. From it the palace receives its highest exterior embellishment, the saloons and chambers thereof are perfumed by its sweets, the arcades and corridors ornamented by its blossoms. Gardening provides the most exhilarating and salubrious luxuries of the banquet; the tables are garnished by its products, and the fruiteries and confectionaries, as well as the green larders, are supplied.

No less is the humble cottage cheered and adorned, when its ivied porch and vine-clad gable exhibit marks of horticultural industry; and this extended into the well-stocked garden, yields many a wholesome addition to the homely fare of the frugal cottager.

For other ranks of society the markets are supplied with a superabundance of the sweets, the delicacies, and wholesome esculents from the garden, forming half the food of man. The loom is furnished with much of its filacious substances, the ship and house builder with their indispensable material; the laboratory is supplied with the chief part of the various qualities from which are drawn or compounded the medicines for human ills; and much of the dyers' colours and artists' tints are obtained from the same productive source.

By the assistance of horticulture our colonies have become the most valuable portions of the face of the earth. By the master mind of a Sloane and others, the art was employed to transport from their native place to the isles and continent of the western world, "the sweet cane," the coffee, fruits and spices, as well as drugs and dyes of the east; and the oriental world is now enjoying many of the natural products of the west*.

Thus horticulture, as the handmaid of civilization, has mainly contributed to promote the interests, administer to the comfort, and provide for the principal wants of all mankind. J. M.

* Tea is not mentioned, because it has not been an object of cultivation in the western world.

De l'Influence des Agens Physiques sur la Vie. Par W. F. Edwards, D.M., &c.

[Continued and Concluded.]

OUR analysis of Dr. Edwards's treatise terminated in the last number but one with the influence of respiration over the production of heat in vertebrated animals. The remaining chapters are devoted to experiments illustrating the phenomena of *transpiration*, *absorption*, *temperature*, *light*, &c., with applications to the human system.

It is impossible to allude to transpiration without immediately conjuring up in imagination the figure of old Sanctorius and his balance, the honest physician accurately weighing himself, so as to calculate his losses by transpiration at different periods, and compared with the quantities of food which he swallowed. But, in his days, the knowledge of physics was at a very low ebb, and hence his aphorisms require the more finished touch of modern physiology.

It appears, that in twenty-four hours the losses which the body sustains in weight are not equal throughout the day and night, but exhibit fluctuations, depending on various circumstances referrible to physical and vital causes. Among the first may be reckoned temperature and pressure, dryness and humidity, repose or agitation of the air; and among the second are, the constitutional health, repose and activity of the body, &c., while some of the physical causes possess a double influence, both vital and physical, such as *light*. Under such circumstances it is clear, that knowledge of physical laws is essential, in order to compute the individual influence of physical agents in retarding or accelerating transpiration. The importance also of this function in the animal economy enhances the value of an intimate acquaintance with its vital relations.

The influence of food upon transpiration is the first object of inquiry. Sanctorius declares this function to be feeblest during the first three hours after a meal. But Dr. Edwards agrees with others in denying the direct tendency of stomachal digestion to retard transpiration. The presence of food in the digestive canal attracts thither, it is true, a flow of liquids from the surface of the body, and thus creates a *temporary* diminution of transpiration.

Sleep seems to possess a direct influence over transpiration in increasing its quantity, as is seen in children at different ages, whose bodies are bedewed with fluid under circum-

stances when neither the temperature of the air, nor their covering, can explain the phenomenon.

Under certain limitations of temperature, the passage of fluid from the surface of the body is accelerated or retarded as the air is more or less saturated with moisture. When the air did not exceed 20° Reaumur in its temperature, Dr. Edwards found a moderate dryness renders the losses of weight by transpiration six or seven times greater than in cases of extreme moisture.

The union of vital and physical causes tends to make the phenomena in these experiments appear complex in their conclusions, and render calculations liable to error. If the air be dry, the waste by transpiration, compared with that of moist air, exceeds, on account of the evaporation of water being most abundant in a dry atmosphere. And this occurs equally in the dead and living body as a physical law. But, in the living state, the increase of transpiration will vary from causes *within*, which modify those acting *without* the system.

When the air is agitated, the temperature of strata of air in contact with the body is affected, and so also is the degree of moisture. If the warm and moist air close to the body be replaced with a cooler air, evaporation is indefinitely increased. The slightest and most imperceptible agitation in the air produces its effect upon transpiration.

The pressure of the atmosphere becoming lessened, the evaporation of liquids is a necessary physical result. In order to ascertain if this took place also in the living body, Dr. Edwards placed one animal under a bell-glass, from which part of the contained air was removed, while another was exposed to the pressure of the air without. The result was, that the animal in the rarefied air lost more weight than the one under ordinary pressure.

Besides the cutaneous transpiration, vapour is constantly exhaling from the lungs, as may be seen by breathing on a mirror, or into a glass vessel. Sanctorius and others knew of this; but their deductions from experiments on the relative quantities are incorrect. Lavoisier and Seguin arrived at better conclusions; for chemistry and physics in general were more understood in their time. These authors estimate the mean daily loss by the lungs and the skin at two pounds thirteen ounces, of which one pound fourteen ounces go off by the skin, and fifteen ounces by the lungs. The loss thus sustained is derived partly from the pulmonic water evaporated, and partly from chemical changes effected by respira-

tion. Though we cannot precisely measure the proportions of the two losses, the former is evidently the preponderating means of dissipating the body's weight through the lungs.

It appears that, whether it be from the skin or the lungs, all aqueous discharge is by evaporation, and the expenditure from the surface of the body far exceeds what happens to arise from the lungs, at least in man, whose structure would lead to such a conclusion. In the lungs the transpiration is most constant, and it fluctuates very much from the skin.

The phenomena of absorption in moist air and in water, are next subjected to experimental examination, which tends to show, that the preponderance of absorption over transpiration, does not solely depend on temperature, but on the greater or less degree of fullness of the vessels. The less the body is saturated the greater will be the absorption ; so that if it suffers considerable previous loss by transpiration from evaporation without subsequent replenishment, it is placed in one of those conditions most favourable for the increase of absorption.

In the chapter following this portion of the work, and which treats of temperature, the curious and interesting experiments of Delaroche and Berger are alluded to. Several species of vertebrated animals were placed by these authors in a temperature varying from 42° 5′ to 45° cent., when most of them remained quiet at first, but after the lapse of half an hour they became restless, and in three quarters of an hour their respiration was hurried on to almost suffocation. The result showed, that vertebrated animals in a dry air, heated to 45° cent., are near the utmost limit of temperature in which they can exist a long time ; for, after recovering the effects of this heat, they were removed to an atmosphere of from 56° 25′ cent. to 65° cent., when, excepting one frog, they all died, and at different periods between the space of twenty-four minutes, and one hour and fifty-five. We know not of human beings supporting so great a heat during so long a time ; but during a short period a higher temperature has been supported. A young man remained twenty minutes in an oven, heated to 210° Fahrenheit, without much inconvenience, when his pulse was raised from twenty-five to an hundred and sixty-four, which is the highest degree of rapidity ; the temperature was nearly that of boiling water. However, M. Berger and Sir Charles Blagden exceeded this, the former enduring 109° 48 cent. during seven minutes, and the latter from 240° to 260° Fahrenheit eight minutes.

M. Delaroche could not remain more than ten minutes and a half in a vapour bath at 37° 5 cent., increased in eight minutes to 51° 25′ cent., and subsequently lowered one degree. M. Berger was obliged to get out of a vapour bath at a temperature between 41° 25′ to 53° 75′; in twelve minutes and a half. He was much weakened, tottered on his limbs, and was affected with giddiness; and these symptoms continued some time. Yet both these persons sustained equal and superior temperatures in dry air during a much longer time, and without any remarkable inconvenience. The sensation in damp air is more intense, and resembles that of contact with boiling water. It is said, that the peasantry of Finland can remain upwards of half an hour in a vapour bath heated to 70° or 75° cent. It is evident, that a bath of hot water, at the same heat, will produce a much more powerful influence upon the animal economy.

M. Delaroche sought to ascertain what increase the temperature of the body acquires under certain degrees of heat. In a vapour bath, heated from 37° 5′ to 48° 75′ cent., the temperature of the body was raised by 3° 12′ cent., as indicated in the mouth. On M. Berger making the same trial with vapour at from 40° to 41° 25′, the temperature of his body acquired 1° 87′ in fifteen minutes. But this object is better achieved by experiments on animals of warm blood than on man. Accordingly, different species of mammiferæ were placed in an oven heated to 93° 75′ cent. Notwithstanding the variety of species, birds, &c. inclosed in dry air, heated as stated above, all of them acquired nearly the same increase of temperature; we may, therefore, fairly infer, from results so uniform, that man and warm-blooded animals, under the influence of excessive heat in dry air, cannot, during life, sustain an elevation of vital temperature beyond 7° or 8° cent. In the cases of the animals last-mentioned, they all died. These results are not applicable in like manner to cold-blooded animals; 40° 93′ cent. is the greatest degree of heat which these were found to reach at the period of their death.

The last physical agent which our author notices, is that of light, and its influence is considered in a two-fold point of view, physically and vitally; for such is its effect upon animal bodies in their living state. This chapter is equally interesting to the pathologist and the natural philosopher. Light will be found, in practice, to be among the curative means of many disorders. The uncovered parts of the human body receive the action of luminous matter, which is

averted by clothing. Among the parts exposed to light, the eyes are specifically adapted to its reception, but not so exclusively relative to reflection of objects of vision. Light must be considered as entering by means of the eyes into the system, as by corporeal contact elsewhere. The exquisitely sensible condition of these organs renders them the most vivid portions of the nervous system, for the transmission of light and its influence upon the animal economy in general. In many acute disorders, light striking upon the eyes not only excites vision, but produces an exacerbation in the whole system.

Having disposed of this agent, Dr. Edwards proceeds to examine into the alterations which the air undergoes by respiration, such as the displacement of oxygen, and the substitution of carbonic acid, with the inspiration and expiration of azote. Experiments are brought forward to illustrate the proportionate exhalation and absorption of azote, and the evolution of carbon during respiration. The results may be shortly summed up in the following manner. The oxygen displaced in respiring atmospheric air is entirely absorbed; subsequently it is carried altogether, or in part, into the stream of the circulation; its dislodgment from the air respired is replaced by a quantity more or less equal to it of carbonic acid exhaled from the lungs, derived entirely or in part from what is contained by the mass of the blood. Also, an animal breathing atmospheric air absorbs nitrogen (*azote*), which is carried into the mass of the blood entirely or partially, where it constitutes the basis of several animal substances; the residue apparently going off by the kidneys, when more is introduced into the system than is wanted.

The importance and complication of the respiratory function are here pointed out, and we learn also that it is one not merely of a chemical character, a simple act of pulmonary combustion; but attended with several vital actions, as absorption, exhalation, &c.

The blood of the animal body, therefore, contains gases derived from respiration of atmospheric air, but not solely from this source. During digestion there is more or less gas evolved in the intestinal canal, which is a subsidiary source, and absorbed from the surface of the mucous membrane. As one proof of this fact, we may refer to the effect of copious draughts of water impregnated with carbonic acid gas, having been known to produce asphyxy.

Dr. Edwards concludes his researches with a chapter de-

voted to the applications of all his positions and results, to which we must refer the reader; for our analysis has already drawn us into a more lengthened detail than we at first contemplated.

In taking leave of this book, we can only, in conclusion, allude to the appendix upon electricity, which the author thus announces in his introduction. "En commençant ces recherches, je me suis bientôt convaincu que les connaissances physiques relatives à l'électricité, n'étaient pas assez avancées pour me fournir les moyens d'étudier son influence sous les mêmes points de vue sous lesquels j'avais envisagé les autres agens. La découverte récente de M. Œrsted, qui lie les phénomènes de l'électricité et du magnétisme, celles de M. Ampère et de plusieurs autres physiciens, forment une nouvelle époque dans la science. Les principes qu'ils ont établis, les instrumens qu'ils ont inventés pour la mesure d'actions inconnues avant, ont fourni à MM. Prévost et Dumas les moyens de faire des recherches très-intéressantes sur les rapports de l'électricité et de l'économie animale. Je dois à leur amitié un exposé succinct de nos connaissances relatives à ce sujet, qui forme un appendix à cet ouvrage."

The subject is unquestionably one of high interest and importance, and the attempt to unite different animal functions, such as the production of heat, muscular contraction, secretion, nervous action, &c. under one law, referrible to electricity, though not at present perfected, is fully worthy of the attention of physiologists.

On Saline Manures. By C. W. Johnson, Esq.

[Communicated by the Author.]

It may not, at the present period, when it is a generally entertained idea that much of the poorest cultivated land in the kingdom will, from the comparative expense of its cultivation, be of necessity abandoned by the farmer; it will not be, perhaps, an useless undertaking to direct the agriculturist's attention to the resources which he possesses in saline manures; by such term, principally including common salt, chalk, gypsum, and bone-dust.

The true definition of the word manure must be much more general in its application than some farmers would suppose; for a cultivator of the rich alluvial valleys of the West of Eng-

land would have little faith in the value of any manure which came not from the farm-yard. A tenant of the heavy clays of Sussex would be loth to consider clay a manure, though he applies sand whenever he can procure it; a Suffolk landowner, on the contrary, amid his wild drifting sands, would be astounded if you told him that sand was a fertilizer. Again, a Kentish yeoman will tell you that "there is no good in chalk," because his land abounds in it; and when he sees ship-loads of this manure leaving his chalky shores for Essex, he is apt to think that on the other side of the Thames the farmers do strange things.

A manure, therefore, may be popularly defined to be any substance added to a soil which increases its fertility.

Many circumstances operate to modify the action of all manures. Soil, climate, seasons, and local situation (as having a northerly or southerly aspect) have all a great and important influence. To give an instance with regard to climate: the same situation which is too retentive of moisture in the West of England may be not sufficiently so in the East; for in Essex and Suffolk the average depth of rain is not one-half that of Lancashire or Cheshire.

Sand, therefore, may be a manure to a clay soil in Cheshire, or Westmoreland, and yet be injurious to the same land if situated in Essex.

We must not, therefore, when we are told of a mineral or saline manure being advocated as an agricultural agent, decide upon its merits, from even our local experience, with too much readiness; for there are few substances found near the earth's surface which, when employed on some soil or other, will not produce beneficial results.

The most universal manure is that from decayed animal and vegetable substances, which acts most probably so beneficially upon vegetables, by gradually combining with oxygen gas, and forming various gaseous matters which are known to be the food of plants. Farm-yard dung, too, contains a great number of saline substances, such as salts of ammonia, phosphate and carbonate of lime, muriate of potash, and common salt; and that these salts form a very valuable portion of the manure is proved by the fact well known among farmers, that a flooded

dunghill loses much of its fertilizing properties, its salts and other soluble properties being thus washed out.

Chalk (the carbonate of lime of chemists) is used in various parts of England to a very large extent; and as it is found in the straw of various cultivated grasses in very considerable proportions, there is no doubt of its being absorbed by the plant as an actual nourishment or food.

There is another reason why chalk is so valuable a constituent part of the soil—its attraction for atmospheric moisture; the turf on a chalk-hill is sure to preserve its verdure in the driest seasons.

On some retentive soils, however, chalk is sometimes added, merely to supply a deficiency in the component parts of the soil, or to neutralize acid matters; and, in many cases, I have no doubt much more chalk is applied than is really needed. I am convinced that, were it properly reduced to a powder, that it might then be spread so evenly and finely over the soil as to produce a given result with one-fourth the usual quantity.

Gypsum (sulphate of lime) probably operates as a manure by entering into the composition of the plant; for its application does not produce beneficial effects when it is applied to any of those cultivated grasses which do not contain it in sensible quantities; its successful use, therefore, has been confined to lucern, red clover, and sainfoin, all of which contain a considerable quantity of sulphate of lime.

Many farmers, from an ignorance of these facts, have been induced to waste much time and expense in its useless application to wheat, barley, and other crops, in which it never appears in sensible proportions.

Bone-dust, though partly a saline manure, (phosphate and carbonate of lime,) is a more compound fertilizer than any I have mentioned; its constituents enter into the composition of the plant, and it abounds with oily and gelatinous matters. The whole being very finely divided, it speedily shows its good effects, which are perceivable for several succeeding crops: this manure is employed in the north of England at the rate of from forty to sixty bushels per acre; and I have every reason to believe that it would be judiciously combined with common salt, the last of the saline manures I propose to mention.

I have elsewhere endeavoured to advocate the cause of salt as a manure at much length, and it has now become the most extensively employed saline agent in the agriculturist's possession.

Common salt is most probably a manure in several ways, for it not only absorbs moisture from the atmosphere, and enters into the composition of the plant, but it kills vermin, worms, &c.

From a long course of experiments with this manure, I have no doubt of its great usefulness and importance to the farmer; although, like all other manures, it requires care and some consideration before it is employed; from a want of these necessary requisites, many an erroneous experiment has been made; many an unsuccessful experimenter sets himself up for a Sir Oracle, with regard to saline manures, with all the confidence of ignorance; and I am sorry to say many are thus decided in their opinions who ought to know better than to judge a most important scientific question by experiments carelessly begun, neglected during their progress, and perhaps forgotten amid the bustle of harvest towards their conclusion*.

Salt has been hitherto most generally employed in agriculture upon the light or barley soils of this country, in the proportion of from fifteen to twenty bushels per acre, with decided advantage, as well as upon all kinds of grass lands.

It has been employed, however, upon grass lands with more *general apparent success* than with any other crop; for whatever other opportunities for careful experiments the farmer may have neglected, yet the fact that his cattle prefer the salted part of the field to any other portion of the same load is always too glaring a fact to escape his notice. He feels that there *must* be something more than usual in the salted grass; and having recollected that he salted that very identical spot, and further having reflected that cattle generally know what is best for them, he hence very decidedly infers that "there is some good in salt for grass."

The market gardeners, and other growers of early vegetables, may perhaps make some use of the following experiment. The

* See my Essay on Salt, second edition; and observations on the employment of salt in agriculture, fifth edition.

crops growing on salted ground, it should be remembered, very rarely suffer by frost or sudden transitions in the temperature of the atmosphere.

In 1827 a bed of early peas in the garden of Richard Francis, Esq., of Droitwich, in Worcestershire, clearly demonstrated this important fact. *Half* the bed had been salted at the rate of twenty bushels an acre, the previous year; the peas growing on the salted portion were gathered full three weeks before the others were ripe, and yielded five or six times as much

The farmers of the coasts of Devon and Cornwall employ, as a manure, large quantities of saline sand, which they get from the sea-shore at low water. The same practice prevails in the north of Norfolk.

Sea-weed is used in considerable quantities by the farmers of the coast of Suffolk and in the Isle of Thanet; this manure ought, however, to be ploughed in immediately it is brought on to and spread on the soil, and not mixed with the farm-yard dung. In Cheshire, they cart large quantities of sea-mud or "sludge" on to their lands: and in Herefordshire, they apply considerable quantities of salt to their cyder orchards.

The Cornish farmers buy, with great avidity, the refuse salt of the pilchard fishery; and although it was objected at a late meeting of the Bath and West of England Society, that such salt might owe all its fertilizing qualities to the oily matters of the fish, yet such an objection is completely answered by the fact, that the Cornish farmers will give more money for the salt which has been only *once* used in salting pilchards, than for that which has been *twice* employed for the same purpose, and consequently contains much more oil and other animal matters.

Sprats and other fish, though not strictly saline manures, are generally found to contain a considerable quantity of common salt and other saline matters; and they might be used to a much larger extent than at present, and as a manure may generally be procured at a cheap rate.

The general employment of this manure in poor inland districts, where it would be most valuable to the farmer, is retarded by their speedy putrefaction, distance from the coast, &c.

If, however, the fishermen were to mix them with one-fourth their weight of lime, they would then form a rich saponaceous

manure, which would keep for any period, and be forwarded into the most inland districts, at the seasons most convenient for the farmer's employment.

A mixture of sprats, lime, and common salt, would form a rich soapy compound of the most fertilizing description; or on the coast, slaking the lime with sea-water, would answer nearly the same purpose.

Supposing forty bushels of the mixture to be sufficient for an acre, the first expense would then not much exceed twenty shillings. Say thirty bushels of sprats, at sixpence per bushel, ten bushels of lime, at the same rate, and half a bushel of salt, at two shillings, would altogether come to about twenty-one shillings.

Common salt and lime when mixed together, gradually decompose each other; the result of the decomposition is soda, and a peculiar deliquescing salt muriate of lime. This salt, from its great attraction for the moisture of the atmosphere, is an admirable fertilizer for sandy hot soils.

A plan similar to this, is actually adopted in China, but instead of fish, night-soil is used with the lime; the whole mass being made into cakes like bricks, is afterwards dried in the sun and sent into the inland provinces for the use of the farmers. So universal is this practice at Pekin, that these cakes are said to form no inconsiderable portion of the circulating medium of that great city.

Sprats are found in inexhaustible abundance on most of the British shores; as much as 120 bushels have been taken at a single haul; they abound in the river Thames from November until March.

The same observations apply to herrings and other fish which are found in great abundance; and it might perhaps be highly useful to establish something of this kind on the coast of Ireland; especially in those places where at certain seasons the supply of fresh fish far exceeds the demand.

The farmer, therefore, who has to contend with a poor soil in a barren country, ought, of all other agriculturists, to turn his attention to the subject of saline manures. If his land wants moisture, let him employ common salt; if it needs animal and other decomposing matters, let him use bone-dust; if his land refuses to bear red clover, sainfoin, and lucern, let him manure it with gypsum.

The improvement of the farmer's resources by the addition of any new manure to his calendar of fertilizers, especially in periods like the present, cannot but be of national advantage.

Saline manures, too, possess this superior value over all others, they do not need to be applied in large quantities, (chalk, perhaps, may be an exception). A waggon will contain, either of bone-dust, gypsum, or salt, sufficient for acres; and this, in poor inland districts, is no mean advantage.

It is perhaps this fact, which in some degree accounts for their success, which has been generally greatest in the poorest counties; for there, the farmer having to encounter nature in her most barren, desolate form, is glad to avail himself of every resource which science can bring to his aid. He listens with patience, examines with care; and if he, even after all his care, fails in his endeavours, he at least acquires knowledge by his most decided defeats.

Great Totham, March 1, 1828. C. W. Johnson.

A Copy of the Law in relation to Weights and Measures recently established in the State of New York.

In the First Number of our New Series we published, with the consent of its author, and of the Commissioners to whom it was addressed, Professor Renwick's "Report on the subject of Weights and Measures, made to the Commissioners for revising the Laws of the State of New York." We have now to subjoin a copy of the Law, in relation to Weights and Measures, which has subsequently passed the Legislature, and is now established in that State.

"Chapter XIX.

Of the Computation of Time, of Weights and Measures, and the Money of Account.

Title 2d.—*Of Weights and Measures.*

"1. There shall be but one standard of measure, of length and surface, one of weight, and one of measure and capacity, throughout this State.

"2. The unit or standard measure of length and surface, from whence all other measures of extension, whether they be lineal,

superficial, or solid, shall be derived and ascertained, shall be the yard, as used in this state on the fourth day of July one thousand seven hundred and twenty-six.

" 3 For the precise definition of the said yard, and in order to its recovery in case of loss, it is declared, (until the measure of the pendulum shall be transferred to some appropriate public building,) that such yard has been found, by experiments made with a pendulum, with a brass rod, at Columbia College, in the City of New York, in the latitude of forty degrees, forty-two minutes, and forty-three seconds, north, to bear to the pendulum of that place, vibrating seconds in a vacuum, and at the level of the sea, at the temperature of melting ice, the proportion of one million, to one million eighty-six thousand one hundred and forty-one *.

" 4. The standard yard thus defined, shall be measured in a straight line between two points engraven upon golden disks, inserted into a straight brass rod; and in case the same shall be lost, or otherwise destroyed, defaced or injured, it shall be restored according to the proportions mentioned in the preceding section, under the direction of the Secretary of State, as State Sealer of weights and measures.

" 5. The yard shall be divided into three equal parts, called feet, and each foot into twelve equal parts, called inches; and for measures of cloths, and other commodities commonly sold by the yard, it may be divided into halves, quarters, eighths, and sixteenths.

" 6. The rod, pole, or perch, shall contain five such yards and a half; the furlong, two hundred and twenty such yards; and the mile, one thousand seven hundred and sixty such yards.

" 7. The acre, for land measure, shall be measured horizontally, and shall be equal to a rectangle, sixteen such perches in length, and ten in breadth, and shall contain one hundred and sixty square perches, or four thousand eight hundred and forty square yards; six hundred and forty such acres being contained in a square mile.

" 8. The unit or standard of weight, from which all other weights shall be derived and ascertained, shall be the pound of such magnitude, that the weight of a cubic foot of distilled water, at its maximum density, weighed in a vacuum with brass weights, shall be equal to sixty-two and a half such pounds.

" 9. Such standard pound weight shall be made of brass, and in case of loss, shall be restored by making a new standard, determined according to the proportions mentioned in the last section, under the direction of the State Sealer of weights and measures.

" 10. The pound shall be divided into sixteen equal parts, called

[* Journal of the Royal Institution : New Series, No. 2, pages 382—385. Ed]

ounces, of which parts the cubic foot of distilled water, under the same circumstances mentioned in the eighth section, shall weigh one thousand.

"11. The unit or standard of measures of capacity, as well for liquids as for dry commodities, not measured by heaped measure, from which all other measures of capacity shall be derived and ascertained, shall be the gallon, which shall be a vessel of such capacity, as to contain at the mean pressure of the atmosphere, at the level of the sea, ten pounds of distilled water, at its maximum density.*

"12. Such standard gallon shall be made of brass, and in case of loss, shall be restored according to the proportions mentioned in the last section, under the direction of the State Sealer of weights and measures.

"13. All other measures of capacity shall be derived from the gallon, by continual multiplication or division by the number two, being in the decending scale, half gallons, quarts, pints, half pints, and gills, and in the ascending scale, pecks, half bushels, and bushels.

"14. The bushel shall contain, at the mean pressure of the atmosphere, at the level of the sea, eighty pounds of distilled water, at its maximum density.

"15. The standard measure of capacity for coal, ashes, marl, manure, Indian corn in the ear, fruit and roots, of every kind, and for all other commodities, commonly sold by heaped measure, shall be the aforesaid bushel; and the measures used to measure such commodities, shall be made round, with a plain and even bottom, and shall be of the following diameters at top, measured from outside to outside; the bushel, nineteen and a half inches; the half bushel, fifteen and a half inches; and the peck, twelve and a third inches.

"16. All commodities sold by heaped measure, shall be duly heaped up in the form of a cone, the outside of the measure by which the same shall be measured, to be the extremity of the base of such cone, and such cone to be as high, as the articles to be measured, will admit.

"17. The measures used for measuring dry commodities not heaped, shall be stricken with a round stick or roller, straight, and of the same diameter from end to end.

"18. All contracts hereafter to be executed, made within this State, for any work to be done, or for anything to be sold, delivered, done, or agreed for, by weight or measure, shall be taken and construed to be made according to the standard weight and measures thus ascertained.

"19. Nothing contained in the present title shall prevent the sale of liquors and wines, paying duties to the government of the United States, by the measure of capacity used in its custom-houses, while in the original casks or other vessels in which the same were imported.

"20. The original standards, which shall be made in conformity to the provisions of this title, shall be deposited in the office of the State Sealer in a chest, under three locks, whereof the keys shall be kept by the chancellor, the chief justice, and the State Sealer for the time being; which chest shall only be opened in the presence of two of such officers for the sole purpose of comparing such standards with the copies hereinafter described; unless by a joint resolution of the two houses of the legislature, or on the call of either house for information, or by order of the governor for scientific purposes.

"21. Copies of the said original standards, to be made of such materials as the State Sealer shall direct, shall be deposited by him in the offices of the clerks of the Supreme Court at New York, Albany and Utica, in chests under two locks, whereof the keys shall be kept by a judge, and the clerk of the court; which chests shall only be opened in the presence of such judge, for the purpose of comparing such copies with the copies hereinafter directed to be deposited with the county clerks for general use; unless by a joint resolution of the two houses of the legislature, or on the call of either house for information, or by order of the governor for scientific purposes.

"22. Copies of such original standards for general use, to be made of such materials as the State Sealer shall direct, shall be deposited by him, in the offices of the Assistant State Sealers, the Sealers of the city and county of New York, and the several County Sealers, who shall severally be responsible for the preservation of the copies respectively delivered to them, and shall cause them to be compared, once every five years, with the copies existing in the offices of the clerks of the Supreme Court.

"23. Like copies of such original standards shall be transmitted by the State Sealer, to the several County Sealers, to be furnished by them to the Town Sealers, in their respective counties, at the expense of the towns.

"24. The State Sealer shall cause to be impressed on each of the copies of such original standards, the letters N. Y., and such other additional device, as he shall direct for the particular county; which device shall be recorded in the secretary's office, and a copy thereof delivered to the respective County Sealers.

"25. The several County Sealers of weights and measures, except in the city and county of New York, shall furnish the

Town Sealer of each town, in their respective counties, with copies of such standards at the expense of the town, on which the County Sealer shall impress, in addition to the state device and the county device, such other device, as the board of supervisors shall direct, for the several towns in the county, which town device shall be recorded in the clerk's office of the county.

"26. It shall be the duty of the Town Sealers of weights and measures, to compare such copies, once in every three years, with those existing in the office of the County Sealer.

"The several Assistant State Sealers, the Sealer of the city and county of New York, the County Sealers, and Town Sealers, shall compare all weights and measures, which shall be brought to them for that purpose, with the abovementioned copies of such standards in their possession; and when the same are found or made by him to conform to the legal standard, the officer comparing them, shall seal and mark such weights and measures."

The remaining sections of this Title contain only some unimportant local regulation.

Remarks on the Ruins at Palenque in Guatemala, and on the Origin of the American Indians, with a note on Fossil Remains. By JOHN RANKING, Esq.

(Continued from our last vol. and concluded.)

GUATEMALA and Yucatan have been proved, by the *remarks* on the ruins at Palenque, to bear strong evidence of their having been peopled by Asiatics; Turks, Moguls, and Calmucs. Identifications of a more general nature will now be given, which will probably not leave any doubt on the subject. They are derived from a Spaniard who is a native of the city of New Guatemala*. When the Toltecs arrived in Guatemala, their king Nima Quiché died during their journey from Tula, and his three brothers divided the country between them. *From this family, all the progeny of kings derive their origin*, (pp. 165, 404). They found the country possessed by different nations, (p. 161)†. The third Toltecan emperor, Hunahpu,

* A Statistical and Commercial History of the Kingdom of Guatemala, from original records in the archives, actual observations, &c. by Don Domingo Juarros. Translated by Lieutenant J. Bailey, R. M. 8vo. London, 1823.

† We have seen that the Toltecs emigrated from Anahuac, A. D. 1052. See this Journal, No. V. p. 143.

is celebrated for *discovering* the use of *cocoa* and *cotton,* (p. 164).

Remark.—It thus appears tolerably evident, that the nations on the arrival of the Toltecs, A.D. 1052, *had neither kings, cocoa, nor cotton, which marks two epochs of population; and some of the following facts give every reason to conclude that a third epoch dates from the invasion of Japan, in* 1283.

Anil is the *American* name for indigo, in Guatemala.—(*Juarros* 263. *Rees's Cyc.* "Indigo.") It was known to the Romans and to modern Europe, by the names of indicum and indigo. *Nil* and *anil* are the Arabic and Asiatic words.—(*Purchas,* vol. v, 570). Those who knew not the use of cocoa and cotton, were not likely to manufacture indigo.

Balam Acan, the fifth emperor of the Toltecs, was carried in a rich chair of state, splendidly ornamented with gold, emeralds, and other jewels, upon the shoulders of his nobles—(p. 174). Sinacam, when he approached in his litter, preceded by trumpets and drums, addressed Alvarado, the Spaniard, as a descendant of the Sun; (having the same awe for that race as the Mexicans and Peruvians;) Sinacam wore a crown, and held a sceptre in his hand.—(pp. 424, 448, *and Las Casas,* p. 41).

The Guatemalans had pyramids like those of Mexico (463). They sacrificed a Spaniard and some Indians of Tlascala, to their Idol Camanelon (p. 443), and others to their Idol Esbalanquen, (p. 471). They used the skulls as drinking cups, and ate human flesh (p. 356).—Such are the *Calmuc* Idols in this journal, No. V. p. 144.

The province of Quiché, so named from the first Toltec leader from Anahuac (p 163), had for its capital the city of Utatlan, the most magnificent in Guatemala while under its native sovereigns. The castle, of hewn stone, was four stories high, 376 paces in front, and 728 in depth; the palaces were equal to those of Montezuma and the Incas. The streets were narrow. The population was so great, that it furnished 72,000 combatants to oppose the Spaniards. There was a superb edifice, in which above 5000 children were educated under 70 masters. In one of the saloons of the castle stood the

throne, covered with four canopies of plumage, and the ascent was by several steps. It contained the treasury, court of justice, the armory, gardens, aviaries, and menageries. The fourth and fifth divisions were for the queens, and royal concubines, who were maintained most magnificently. The sixth division was for the king's daughters, and others of the blood royal (pp. 85—88). There were many other considerable cities in this, said to be the most populous portion of America at the Spanish conquest.

After *Mitlan** was taken by the Spaniards, they marched to Esquipulas and to the city of Copan ; the name of the Cacique was *Calel*†. There was a great circus near this opulent and populous city. Calel had 30,000 veteran troops armed with bows, slings, and swords with stone (flint) edges. His entrenchment was defended on one side by a mountain, and by a deep fosse formed of strong beams, the interstices filled with earth, in which were embrazures and loop holes, for the discharge of their arrows at the enemy. A shower of pikes, stones, and arrows, obliged the Spaniards to retreat precipitately ; the next assault lasted the whole day. The Indians had shields of tapir skins‡, and with pikes hardened in the fire, obliged Hernando de Chaves again to retreat. In the next desperate conflict, a part of the palisade gave way, and the cavalry entered: the Indians fled. Calel quickly returned reinforced, and was defeated, but escaped. He afterwards sent ambassadors with a present of gold and a mantle to Chaves, and was received into protection with great distinction. Near this place, on the farm of Penol, some *gigantic skeletons* were found, the shin bones of which measured near two varas in length, a vara is thirty-three inches English (pp. 45, 303.) In the valley of Petapa near Old Guatemala, a molar tooth was found, as large as a man's two fists, (p. 192). (Here is a chief with a Mogul name, elephants' bones, and a stockade like those of the Burmese and Assamese. The writer has

* There are ruins of some elegance at this place, which are not supposed to be of an older date than the thirteenth or fourteenth century. Humboldt, ii. 158

† This is a Mogul name ; *Calil* was grandson and successor to Tamerlane.

‡ Tapirs are often mentioned by Juarros, as very numerous in Guatemala. This noble region is the Italy of America. Some of the cedars are seven fathoms in circumference (p. 233).

conjectured, that part of the Japan expedition was from Assam, which at that period belonged to the Moguls.)

At the conquest of Quiché, the Spaniards were opposed by Tecum Umam, who had 232,000 warriors. "He had fortified towns, and in his camp were several military machines, or small castles, formed of beams and planks, which, being placed upon rollers, were moved by armed men. They were filled with great quantities of pikes, arrows, lances, shields, slings, and stones; and attended by chosen bodies of soldiers, to distribute them, (p. 390)."—This is very like the warfare of Genghis Khan and Tamerlane; the arms are the same. The only difference is, that in Asia, the military machines were drawn by cattle. The golden chair, schools, indigo, architecture, idols, throne, menageries, arms, stockades, and remains of elephants, all tend to prove that Calel was a Chinese Mogul. It is very curious, that some natives of India, in the neighbourhood of Ava, are described in the Periplus, (*Sequel by Vincent*, p. 115), with "heads long from the forehead to the chin, and projecting like the face of a horse." See the plate in this Journal, No. V. p. 144. Ava had been invaded by Oguz the Turk, about 650 years B. C.

The manuscript of Francisco Garcia *Calel* Tzumpan Xavila, a descendant from the kings of Quiché, written in 1544, relates that thirteen armies left the *old continent*, headed by as many principal families, who were all related, but five were more illustrious than the rest—the families of Capichoch, Cochohlam, Mahquinalo, Ahcanail, and Belehebcan*. From Capichoch the family of Nimaquiché and all the royal Guatemalans are descended. *The Quiches and Mexicans were of the same race and acknowledged relationship.* When Montezuma was imprisoned by Cortez, he sent a private message to Kikab Tanub for assistance†. A certain stone which their forefathers had brought from *Egypt*, and which they worshipped, split in two

* In personal names this may mean *Khan*. Genghiscan is the usual spelling of French authors.

† The Mexican History relates, that Montezuma's predecessor carried his victorious arms to Guatemala. It is, however, denied by Juarros that the Mexicans conquered that kingdom: he says they were repulsed, but that *vast numbers* of Mexicans were sent, under the disguise of merchants, to settle themselves preparatory to future endeavours.

suddenly, which omen portended certain ruin*. The Indians, who came with the Spaniards from Mexico and Tlascala, were persuaded of the *identity of their origin with the Guatemalans. Juarros*, p. 165. It was in Veragua, the south province of Guatemala, that Columbus saw the first solid architecture of stone and lime, and *copper* hatchets at Honduras. He found a warlike people, and a chief, at whose dwelling 300 skulls of enemies were exhibited. Columbus felt persuaded that this was the coast of Asia. (See *Life of Columbus*, by Washington Irving, vol. iii. pp. 200, 225, 259.) Thus the architecture and civilization of Guatemala cannot be referred to an *earlier* period than A.D. 1052, and much of it is no doubt considerably later, from its corresponding with the gigantic style of the Peruvians and Mexicans.

Since the publication of No. V. of this Journal, the writer has conversed with Mr. Herrick, who had been an agent for a fur company, and who resided several years with the Indians. The Winnebagos, near Lake Michegan, he recognised instantly, in the portraits of the Palenque inhabitants, some of which are *complete* resemblances. He describes them as a tall, well-made people, brave, honourable, and dignified in their deportment; and that they sit cross-legged, and smoke their pipes just like the Turks of Europe, to whom they bear so strong a personal likeness. They also make exactly the same rude drawings and marks as those represented in Strahlenberg's History of Siberia. (Since writing the above, the heroic deportment and description of *Redbird*, their wealthy chief, who voluntarily surrendered himself to justice, for killing a man, and who died in prison, is a confirmation.—*Morning Herald*, June 2, 1828.)

We shall now describe some other Indians. "We passed by a village of the Cappa, (lat. 34°.) They worship but one divinity, which discovers itself in a certain animal, such as it shall please their jugglers, or priests, to pitch on †. When that animal dies there is great mourning, and a new mortal deity is

* The Mexicans and Peruvians, it has been shown in their history, were equally superstitious with regard to omens. "Para Hotun, which means the city of the Tiger, was built on the Kerlon in the time of the Grand Kublai, and was so named from the cry of a tiger, which they thought a good *omen*."—*Du Halde*, ii. 251.

† This is precisely a *Calmuc* custom.—*Pallas*, vol. i. p. 570.

taken from among the brutes. The Arcansas gave us guides, who conducted us down the Mississippi, and to the Taensas*, a people who give place to none in America for their force, or for the beauty of their climate. The village is on the side of a lake eight leagues in circumference. The grandeur of the village, the cottages, in rows, built of earth and covered with cane, surprised us. The prince's palace and the temple were each forty feet square, the walls ten feet high and two feet thick; the roof, in form of a cupola, was covered with mat of divers colours. Before the palace stood twelve men, armed with half pikes. An old man led me by the hand into a great square hall, the floor and sides of which were covered with very fine mat. At the end, opposite the entrance, was a very handsome bed with curtains of fine stuff woven with the bark of mulberry-trees. The prince was upon this bed, as a throne, encompassed by four handsome women†, and sixty old men armed with bows and arrows. They were clothed in very fine white garments; that of the prince was adorned with tufts of different colours; he wore upon his head a diadem, curiously woven with rushes, enriched with large pearls and a plume of feathers. The women were similarly dressed, and all had necklaces and fine ear-pendants of pearl, bracelets of woven hair, and jewels upon their attire. They were brown; their visages rather flat; their eyes pretty large, black, and sparkling; their shape was fine and free; and they had a smiling and very pleasant air‡. I addressed the venerable prince relating to the

* Near Mob'le.

† The Emperor of China, when he gave audience in 1419, had four handsome women, with great pearls in their ears, attending his throne.—*Wars and Sports*, p. 175.

‡ Pallas's description of the Calmucs (see this Journal, No. V. 149,) corresponds with this. The tribes are numerous. Dr. Clarke, in the Cossack country, met with a tribe, ugly and nearly black; they ate dogs, cats, rats, and marmots, dried in the sun. Some had handsome features, with single-braided hair, if a virgin; two braids, if married; and wore shells, or pearls, or something like them, in their large ears. In their spacious tents they had handsome carpets, mats, very good beds and domestic utensils. They are giants, when compared with Laplanders, and their manner of living is much superior. They have a complete aversion to living in houses or towns. They intermarry with Cossacks, and the union produces, sometimes, women of very great beauty, though nothing is more hideous than a Calmuc.—Part I., Chap. xii. Thus it appears that there are very different people in colour and features who are named Calmucs They intermarry with Turcomans (*Pallas*, i. 575,) and probably with many other tribes, not improbably with Indians in Tangut. The idol, with six arms, of which Dr. C. has given an engraving, he says, is *Diva triformis—Luna, Diana et Hecate.* There is a very elegant engraving of the same idol in *Chappe D'Auteroche*,

mission from the French King, who hearkened to the interpreter with great attention, embraced me, and gave me assurances of his respect and veneration for his majesty. He received the sword, razors, and presents with joy. I gave the ladies some neat scissors, a tortoiseshell knife, and some pins to use in lieu of their thorns, with a silver thimble, and some needles. The finest of the women, seeing me admire her necklace of large pearls, insisted, with abundance of civility, on my acceptance of it. One of the ladies, on receiving a present, squeezed my hand pretty hard, which gave me reason to suppose that they might easily be tamed, and taught the politer arts of conversation. The prince invited me to stay the night, and gave me in charge to an officer, who conducted me into such an apartment as that of the king, and they brought me a collation of wild-fowl, fruit, and liquors. The old gentleman who was with me, acquainted me that they obeyed their sovereign's absolute will, and owned his children as his lawful successors; that when he died, they sacrificed his chief wife, his steward, and twenty men to serve him in the next world; that when he went out, the roads were strewed with sweet herbs, and no one moved while he was passing; that no one could drink out of his cup or eat out of his dish. They worship the sun, have temples, altars, and priests, and a perpetual fire as the emblem of the sun.

"In the spring, they go in a body and *turn up a large space of land*, with drums beating all the while*. In autumn, they gather their Indian corn, keep it to the next June, and then feast on cakes made of it. On the top of the wall of the temple are several pikes, upon which are stuck the heads of their enemies and of criminals. On the front there is a knob, covered round with hair, and above that a heap of scalps in form of a trophy. The inside of the temple is only a nave painted at top, with all sorts of figures; in the centre is a hearth, and three billets upright always burning, attended by two priests in white vestments. Round this, prayers are said at sunrise,

vol. i. 313. The name of this Calmuc goddess is *Nangilma*. It has an eye in each of the three foreheads; one face is *white*, one *black*, and the third is a *medium* colour. The Abbé could not get any details respecting it. There is another named *Tarni Negonizan Bourchan*, with three heads and twelve arms, and three children in her arms, much resembling the Manippe of Thibet. Dr. Clarke gives another, which he calls the Osiris, or Bacchus of the Calmucs. It is these resemblances of the Calmucs to the Egyptians which have misled theorists regarding America.

* The Incas did the same.—*Conquest of Peru*, 197.

noon, and sunset. There was a sacred closet, with a couple of spread eagles at the top looking at the sun. Here were deposited their gold, jewels, and pearls. Some time after my return to M. de la Salle, the prince came to us in a magnificent barge, with drums beating, and the women that attended him playing on several instruments, some in his own, and some in other barges. The prince gave M. de la Salle *six of his richest robes, and a collar of pearls*.*"—*M. de la Salle's last Expedition, 26th March,* 1693, *in Collections of the New York Hist. Soc.,* 1814, vol. ii. p. 265—276.

The Indians of the Missouri, described in Brackenridge, p. 185, are interesting: he says—

"A few days after our arrival at the Aricara village, we heard it in great commotion before day-light. The chief had arrived after defeating the Sioux; two or three of his men were killed and ten wounded. His army, 300, was expected to enter the village in triumph; the horse and foot advanced in regular procession with a slow step and solemn music, in alternate platoons of 12 abreast, and extended a quarter of a mile; their banners were the buffalo, bear, pheasant, and dog. The troops wore cinctures and crowns of feathers: the whole joined in song and step with great precision. Their few scalps were divided in small locks of hair, to make a show, and fastened on long poles. The scene was truly affecting, fathers, mothers, brothers, wives, sisters caressing each other, without interrupting the solemnity of the song and the step. A youth badly wounded kept himself upon his horse with a calm countenance; his mother threw her arms round him and wept aloud; he shortly expired. The inhabitants were dressed in their finery, their painted shields and trophies were raised on high poles near the lodges; music, songs, and dances, by females with the arms and parts of the dress of the men, were kept up after the dinner, which consisted of buffalo and dog meat, and homony prepared with marrow. One of the dancers caused loud laughter by her recitations. The chief showed me some dressed buffalo robes, upon which he had rudely painted his battles, but there was

* The Natches, not far from this prince, were near perishing *during their long voyage*, and the above are like them in many respects.—The first Natches came to the Mississipi from Mexico before the arrival of the Spaniards, and the remains ollowed after the conquest by Cortez.—*Du Pratz*, vol. iii. ch. 5. There is a tribe ear them, named *Mongoul*atches.—*See Charlevoix*, vol. i. p. 259.

nothing that could convey the idea of *time*, being simply tracks of feet."

The *Creeks* or *Muscogulges* say they came from the south-west, beyond the Mississippi, and established themselves on the ruin of the Natches, before the English settled the colony of Carolina. (The Chicasaw, Chactaw, and Natches speak the language and dialects of the Muscogulges, (163).) Their government is strict, and so civilized that it seems impossible for them to act out of the common high road to virtue, (209). The Creeks have sworn that they will not make peace with the Chactaws while the rivers flow (390).

The manner of conducting their mystical fire is peculiar and solemn; two notes sung by a slave as long as he has breath strike the imagination with religious awe, sounding like *a-lu-yah.* A skin stuffed with tobacco is laid at the king's feet; it is of an animal of the king's tribe or family, a cat, bear, young tiger, &c. The king smokes his pipe first, ceremoniously blowing some smoke towards the Sun or Great Spirit, to the four cardinal points, then towards the white people. In a secluded place they deposit the sacred things, the physic pot, rattles, chaplets of deers' hoofs, and the imperial standard or eagle's tail, which is pure white during peace, but tinged with vermilion when displayed for war. The walls of the houses are decorated with paintings and sculptures of men in variety of attitudes, some with the head of a bear, fox, wolf, &c., and figures of such animals with human heads. The pillars of the council-house are formed like vast speckled serpents ascending, the Ottasses (of this town) being of the snake tribe, (450—454). The region between Savanna river and Oakmulge, east and west, and from the sea-coast to the Cherokee, or Apalachian mountains, is remarkable for high conical hills and terraces. It was possessed by the Cherokees since the arrival of Europeans, but they were afterwards dispossessed by the Muscogulges, and all the country was probably many ages, before the Cherokee invasion, inhabited by one nation, ruled by the same system, but so ancient that the Cherokees knew not their purpose. Perhaps these pyramidal mounts served for look-out towers, or high places for sacrifice (518). The Muscogulges bury their dead in a square deep pit under the couch which

the deceased lay upon in his house, lining the grave with cypress bark; the corpse is in a sitting posture, as if alive, with his gun, tomahawk, pipe, and other matters he most esteemed, (513).

The women are seldom above five feet; they are well-formed, have round features, large black eyes, and are modest, subtile, and affectionate. Their feet and hands are not larger than those of Europeans at the age of ten. The men are a full size larger than Europeans; they are warlike and merciful, but arrogant. According to their own account, which I think is true, *after their arrival* in Carolina and Georgia, they allied themselves to the British, and their aged chiefs yet speak of it with tears of satisfaction and joy. They have furious war with the Spaniards. As to their morals, they certainly do not stand in need of European civilization; I saw a young Indian, who, beholding a scene of mad intemperance and folly, clapped his hands to his breast with a smile, and looked aloft to the good and great Spirit, as if sensible of his favour to the red men, (482—491). They rejoice at the appearance of the new moon, and suspend silver crescents round the neck. They puncture the skin with a needle and mark it blue, with the sun, crescents, stars, and animals. The females are bare-legged, wear buskins, a large long cloth put on differently from a petticoat, and a short waistcoat of calico, but no shift; their hair is plaited and fastened on the crown with a silver brooch and decorated with ribands. The priests wear white, and have an *owl*-skin stuffed ingeniously, which they bear upon their arm or wear upon the head. In the spring, the whole town is summoned to bring their hoes and axes, to proceed to the plantations and begin to plant on the same day, (482—508.) *Travels in Carolina, Georgia, and Florida*, by W. Bartram, Dublin, 1793.—*Note.* The Muscogulges are in the above description a mixed character of Siberians and Moguls. Their religion and customs are Mogul, Chaman, and Tibetian mixed. The *owl* was not held in peculiar veneration till it saved Genghis Khan's life, and white was the dress of the Mogul priests.

The *Seminoles* were going to war with the Chactaws. Their king, Mico Chlucco, the long warrior, (whose portrait is in the volume,) has the noble expression of gravity and dignity, and

much of the features of a Turk. He applied to Mr. M'Latche for a supply of blankets and other stores on credit, till he could repay his old friend Mr. Spalding with buckskins, furs, and other produce of their huntings. Mr. M. hesitated to assent for so large a sum, without the Company's permission. The king, agitated at his offended dignity, with great emotion and anger exclaimed, "Do you presume to refuse? you know who I am, and what power I have; but perhaps you do not know that I could command the fiery shafts of the thunder now rolling to lay you prostrate at my feet, and consume you and your stores to ashes!" Good humour was resumed on credit being granted for half the amount. He was a powerful chief over an extensive and beautiful country in Florida.—(p. 255.)

A young Seminole prince, above the middle stature, was the most perfect human figure I ever saw; graceful, familiar, and dignified: he was in pursuit of a young fellow who had fled with his favourite wife or concubine: he said, merrily, that he would have the ears of both of them. This was their legal punishment for adultery. (243.) The Seminoles speak the Muscogulge and Stincard * tongues. (462) *Bartram's Travels.*

The Chactaws are called *flat-heads*; all the *males* are placed when born in a portable cradle or wooden case, hollowed to receive the infant, who is fixed prostrate upon its back; that part where the head reposes is fashioned like a brick mould, and a bag of sand is laid upon the forehead, which, by continual gentle compression, gives the head somewhat the form of a brick from the temple upwards, and by these means they have high and lofty foreheads, sloping off backwards †. They are a hardy, subtle, intrepid, ingenious, and virtuous race. They erect a scaffold twenty feet high in a grove ‡, upon which they lay

* There is a race of Tartars so called by the Chinese. See *Remarks on the Natches, Conquest of Peru*, p. 255.

† The Spaniards prohibited these customs where their influence locally prevailed; but we find them still in existence in many places, and when more generally practised, there were probably fantastical shapes that are no longer found. There is no proof of such *crushings* of the skull and brain affecting the *intellect*.

‡ This is still a custom with the Nisovian-Tungusians.—(*Harris's Voy.* vol. ii. 929.) A great difficulty arises in the comparisons where the corresponding people in Asia, like the Turks and Moguls, have adopted the Koran.

their dead, and after a sufficient exposure, the bones are placed in a coffin, fabricated of bones and splints, and deposited in the bone-house. The relations and multitude follow with united voice of alternate Allelujah and lamentation. (514, 515. *Bartram's Travels.*)

The males of the Cherokees, Muscogulges, Seminoles, Chicasaws, Chactaws, and confederate tribes of Creeks, are tall, well shaped, perfect figures; the countenance open, dignified, and placid; the eye rather small, black, and full of fire; the nose inclining to aquiline; the forehead and brow strike you instantly with heroism, and their air and actions exhibit magnanimity and independence; their complexion is a reddish brown, their hair long, black, and coarse.—*Bartram*, p. 481.

A company of Cherokees approached, all well mounted on horseback, and headed by their emperor, called the Little Carpenter*. I turned off the road out of respect: he graciously placed his hand upon his breast, saying, I am Ataculculla, shaking me by the hand, and asked me if I knew it? I assured him that I did, and that his name was dear to his white brothers of Pennsylvania.

At the town of Cowe they construct their houses oblong, of trunks of trees notched at the ends, placed on each other, and plastered inside and out, and roofed with chestnut bark or shingles. The council-house is a large rotunda, upon the top of an ancient artificial mount. They found such mounts when they arrived from the west, but know not their use. The rotunda has but one large door to admit light. There is a circle or range of sofas covered with mats or carpets curiously made of splints of ash or oak woven together. Near the great pillar in the centre there is a fire of dry wood, and but little smoke; here they exhibit dances and festivals almost every night. Their dances or musical entertainments are theatrical exhibitions or plays, varied with comic or lascivious interludes. The women, however, conduct themselves with becoming grace and decency, insomuch that, in amorous interludes, when their

* Do this chief and *Red Jacket* take these names, like the Calmucs, from the first person who is seen after their birth?

responses and gestures seem consenting to natural liberties, they veil themselves; just discovering a glance of their sparkling eyes and blushing faces expressive of sensibility*. They are tall, with delicate frames and perfect symmetry. Some of them are nearly as fair as Europeans. The men are the largest race I have seen, their complexions of the olive cast. They are dignified, frank, grave, and honest. (362, 369, 483. *Bartram's Travels.*)

"The Shawnese prophet, the brother of Tecumthé, we think was a fanatic who had *seen visions and dreamed dreams.*" During the time of rigorous 'Fasting,' called in Chippewa, *Makatea*, many rites are practised to excite the feelings to a proper degree of susceptibility. The guardian *Manitou* finally appears in a dream, assuming the shape of some animal, which is during life the object of adoration, and governs the future life of the dreamer; if it be an eagle, he must be a warrior; if a wolf, a hunter; if a turkey buzzard, a prophet or physician. The Shawnese, whatever was their origin, were intruders on the north-western Indians.—(*Remarks on the Indians of North America*, p. 49.) There were *Yankas* or Shamans in the fasts and religion of the Incas.—(*Conquest of Peru*, 185.) In every town of the Creeks they have a juggler or priest, who foretels rain, cures diseases, invokes evil spirits, &c.—(*Bartram*, 495.) †

Remarks on the Cherokees, Chactaws, Muscogulges or Creeks, Seminoles, and Shawnese.—A Buratsky Shaman, says Mr. Bell, who was also a priest, was introduced to us. He gave us a specimen of his art in a tent: we found him sitting with his companion round a fire, and smoking tobacco; he then placed himself cross-legged, took a stick in each hand to beat time to a dismal song, and his followers joined the chorus. He distorted his body, wrought himself into such fury that he foamed at the mouth; his eyes were red and staring, he started on his legs, and fell a dancing like one distracted till he trod out the fire with his bare feet. One would have imagined him possessed by a demon: the vulgar think them the operations

* This is a good description of a *nautche*, such as are seen in the East Indies.
† These are complete Siberian customs.

of a divinity. He then went to the door and gave three dreadful shrieks to call his demon, and sat down composedly to answer questions, which he did, but ambiguously. He then stabbed himself with a knife, and brought it up at his mouth, ran himself through with a sword, and other tricks of jugglers, who impose on the ignorant and credulous. Most of the Siberians have shamans, and hold them in great esteem. They say they are informed of past and future events, and correspond with the shaytan or devil *. In Baraba we visited a famous woman. She brought her shaytan, which was a piece of wood with something like a human head, adorned with silk and woollen rags, a small drum hung with rags and rings, and began a dismal tune, keeping time with the stick on the drum, &c. She was very handsome, and answered questions with as much art as any oracle.—(*Bell of Antermony*, 8vo. p. 152, 192.)

The Kamtshadale shamans consult and command the elements, and are prophets and physicians.—(*Krachenneníkof's Hist.* p. 74.)—It appears that these were not the ancient settlers in Florida, &c. They bear strong evidence of being Siberians.

The Rev. Mr. Beatty in 1766 received the following tradition from some old men of the Delaware tribe: That they knew not for certainty how they *first came to this continent*, but that a king of their nation, *far to the west*, left his kingdom to his two sons, who made war, and one of them emigrated with a number of people, and after forty years wandering, they settled at the Delaware river 370 years ago, which they knew by their *wampum* beads. The king of their country whence they came some years ago, (when the French possessed Pittsburgh or Fort Duquesne) sent some people to discover them, who, after seeking six years, met a Delaware whose language they understood, tarried one year, and returned. The Delaware women follow exactly the custom of the Jews, and observe the first fruit or green corn feast. (Mr. Williams asks if this does not refer to Joshua and the Israelites, or to Madoc; and adds, that the *Tartars* are descendants of the ten tribes,

* Is not this the Manitou of the American tribes?

and may have been brought upon ice by a sudden thaw.) They distinguish themselves by the name *Lenee Lenaupé.* Lenee signifies *man*, or, properly, male. Mr. Heckewelder (whose entire life was passed among the Delawares) says, that Lenape means original.—(*Remarks on Ind. of N. Amer.* 18.) The Indians on Hudson's River called the Europeans Woapsid *Lennappe*, which means white *people* (*Yates and Moulton*, p. 255.) Morse says Lennilenape signifies Indian men, (title Delawares.)

The Lenni Lenape, say they, resided many hundred years ago in a distant part of America *West*, and after a long journey they arrived at the Mississippi, and fell in with the Mengwe, (Iroquois or Five Nations,) who had emigrated from a distant country. East of the Mississippi, the powerful nation called *Alligewi* resided in towns; from them the Alleghany river and mountains derive that name. These famous people were very tall and stout, and there is one tradition that there were *giants* among them much larger than the tallest Lenape. They built regular fortifications and entrenchments, whence they would sally. but were generally repulsed. One of them is at the mouth of the Huron, flowing into Lake St. Clair; the other on the Huron, east of Sandusky, six or eight miles from Lake Erie. The Lenape requested permission to settle; the Alligewi refused, but gave them leave to pass through and go eastward. When the Alligewi saw their vast numbers, they attacked the Lenape, who, fired at this treachery, joined with the Mengwe. Great battles, for several years, were fought; many fell, fortifications were erected, no quarter was given, and *the Alligewi fled down the Mississippi, and never returned.* The Mengwe settled by the great lakes, and the Lenape to the south. They rapidly increased, and at last settled on the rivers Delaware, Hudson, Susquehannah, and Potomac. It is supposed that more than half of these nations remained west of the Mississippi. The Delawares, on the shores of the Atlantic, divided themselves into three tribes, the Turtle, *Turkey*, Wolf*: the Turtle call

* The wolf was the Turkish banner in Asia, A. D. 545. The Grand Khan's throne was supported by *peacocks*, and large stone turtles were found at Caracorum, the Turkish capital, conquered by the Moguls.

themselves *Unamis;* the Turkey, Unalachtgo; which two settled between the coast and high mountains. The Wolf tribe, called *Minsi,* were the most warlike, and lived in the rear, watching the motions of the Mengwe. They had their council-seat and fire at Minisink. These were divided into new tribes and intermarried, each tribe being named after natural objects. (*Yates and Moulton,* 32—36.)

The Rev. S. Kirkland, in 1788, describes an ancient fort on the *Genesee,* which inclosed six acres, and had six gates; the ditch was eight feet wide, six deep, and circular on three sides, the fourth was a high bank defended by a fine stream. The bank had probably been secured by a stockade, as there appeared to have been a deep covered way down to the water. Some of the trees appeared two hundred years old. Half a mile south there were ruins of another of less dimensions and a deeper ditch. On the river Tanawaude, distant twenty-six miles, there were vestiges of a double fortified town, with six gates, and like the first above-mentioned The ditches he thought had been much deeper originally. Here were the remains of a funeral pile twenty-five feet in diameter and six high; many bones were visible. The best information Mr K. could get from the Indians was, that battles had been fought there before the Senecas were admitted into the confederacy, three hundred years ago, when they used arrows, spears pointed with bone, and war clubs; the latter of which were used when the first were expended. They wore a coat or jacket of mail, made of sticks, and a cap of the same*. Above 800 fell; some say it was four or five hundred years ago. These battles probably refer to the Allegewi, who had constructed these works, and were driven away down the Mississippi. *Many think these were the original countries of the Mexicans and Toltecas.*

May we presume that the Alleghanians and Mexicans were the same people, by intermixture, and that the former erected these works before the Lenape and Iroquois came, and destroyed them? Many of these fortifications were temples; that of Circleville, in Ohio, was one where human sacrifices were one of

* Calmucs and Moguls wore the same, made of iron.

the rites, and where female victims, as in India, were *immolated* with the males *. Their similitude with those of Mexico has been traced, and idols of baked clay, consisting of three heads, like the triad of India, have been found. (*Yates and Moulton*, 15, 39, 42, 44.)—*Note*. By the historical proofs in these notes, the Toltecs are Turks, from the river Tula, near lake Baikal, and they named their city Anahuac, (Anahuatlaks means inhabitants of the banks of rivers, *Humb*. i. 82), after their *native* place. As the *Lena* and *Jenesai* were then belonging to the Turks †, it may be conjectured that *Lenee* Lenape means *Lena-men*; and it is remarkable that *Genesee* should be the name of a river in America, among the same people ‡. The Allegewi are undoubtedly Caribs, and Caribs are Calmucs and Mongols, as will be proved. The idol with three heads is the Calmuc idol, *Nanqilma*. A portion of the Turks might be from the Lena, but the chiefs from Tula, from which the word Toltec is derived. This appears a probable derivation of the Lenee Lenape; with this assistance the truth may be ascertained in America, by any one who will procure the most accurate traditions, and compare the features and customs and dates. The resemblances are too remarkable to be passed in silence.

The traditions of the Caribs are, that they migrated from the Apalachian (Alleghany) mountains, to the extremity of Florida, and thence to the Lucayos, from island to island, Porto Rico, Guadaloupe, (their citadel,) Tobago, &c.§; thence to Guayana, and some to Brazil. They spread terror, and were very superior to the surrounding Indians, (*Irving's Columbus*, vol. ii. p. 32.)

"The country of the *Caribs* (which means *strongest*,) exceeds all Europe in dimension. They pluck out their beards

* This probably means killed, (not *burnt*.) as in Peru and Mexico, to be buried with their lords.

† In De la Croix's Map those regions in Yakutsk are named *Northern Turquestan*. These and other elucidations may account for Heckewelder's Long River, (the Lena is said by Tooke to be 5000 versts long).

‡ The Genesee in America has water-falls, as well as the one in Asia, (see Morse and Tooke).

§ "It is singular that *Antigua*, which, in the language of the larger islands, signified *a country abounding with springs*, should in the dialect of the Caribbees, have been applied to an island that has not a single spring or rivulet of fresh water. The inhabitants use rain water."—*Morse's Gazetteer*, "*Antigua*."

with pincers, they bore their ears and nostrils, and the richer sort deck them with jewels of gold, the common people with shells; and cut the hair to half the ear. At puberty they chew leaves of trees and nuts in either cheek all the day, which blackens their teeth. They reproach Europeans for keeping their beards and hair, and having white teeth, with being like wild beasts. The Chiribichenses cultivate the leaves, which are greater than myrtles, in well-ordered trenches, watered, in fields inclosed by a cotton line three feet high, and think that whosoever passes that sacred line, shall shortly perish. They pick up exceeding plenty of shells and snails in the woods and mountains, heap them up, and with certain wood they put them into a furnace, make lime, and mix it with the powdered leaves. The powder thus mixed and tempered, they put up close in maunds and baskets of marish canes, curiously wrought." The merchants flock to them, as to a fair, to buy it, for which they give slaves, golden jewels, and maize. These people spit out and change the old leaves for new, every hour. Peter Martyr, (who died in 1525,) *Decade* viii. c. vi. in Hakluyt, vol. iv. p. 665. Those who have been in India will read all this with great interest; the use of the word *maund* is exceedingly remarkable. A maund in Hindostan is from twenty-four to seventy-five pounds English, (*Rees's Cyc. Maund.*) This English translation from the Latin (the latter has not been met with,) appears to have been published before 1588, (See *Rees's Cyc. Hakl.*) and the first ship from England to the East Indies, was the *Rere Admiral*, Master, (afterwards Sir) James Lancaster, in 1591. This word *maund* was, therefore, not probably known in England, and if it be the same in the original Latin, as the word used in America before 1525, it is a very curious circumstance.—*Note.* The writer of this has seen a kiln of such shells burning in the Sunderbunds, for the like use in Bengal. See *Wars and Sports*, p. 288.

The Caribs are well-made, have a full round face; *the nose and forehead are pressed and flattened by their mothers while infants.* They blacken round their eyes. If the first-born be a male, the husband keeps his bed, as if suffering from childbirth. They have *Chemeens*, and follow their devilish magic.

(*Hennepin, Voy. dans l'Amér.* p. 539, 580, 587, 590).—*Note.* This *remarkable* identification with the Calmucs, respecting the nose, has been found since the last Journal was published. (See p. 149.) The Calmucs have *Schamanes.* They take in each hand some roots, which they light, and sing, *Dshi eio io io*, become quite furious, and then answer questions about lost property and predictions. (*Pallas*, i. 570).

Before the boat could reach the land (at Guadaloupe), a large number of resolute females issued from the woods armed with bows and arrows, preparing to oppose any descent upon their shores. Having explained to these Amazons that we only sought provisions in exchange for articles of great value, they referred us to their husbands at the north end of the island. The warlike spirit of these armed bands led Columbus into the erroneous idea that these islands were inhabited entirely by Carib women. The Spaniards were told that the Caribs deprive their young male prisoners of their virility, to rear them to man's estate, and fatten them for food. We would fain attribute these accounts to mistakes, but they are too positively affirmed by respectable writers. (*Washington Irving*, ii. 18, 318.)—*Note.* The women of Great Bucharia go to the wars with their husbands, (*Abul Ghazi*, notes, p. 460). Durgetti, queen of Gurrah, and famous for her beauty, was mounted in a castle upon an elephant, clothed in armour, with a helmet upon her head, a lance in her hand, and a bow and quiver. She led on 1500 elephants and 8000 horse, and laid 600 Mogul horse dead, and then pursued the rest till evening, with great slaughter. (*Dow's Hindostan*, A. D. 1564.) Aladdin, Sultan of Sumatra, had a hundred galleys, some of which carry 400 men. The admiral was a woman. (*Harris's Voy.* vol. i. 145.) The king of the *city* of Bangalla has 2000 elephants, and a great army. His chief guard consists of women, as in Java, Sumatra, and Fransiane; they are valiant, expert horse riders and vaulters, and use the scimitar, buckler, and battle-axe dexterously. All prisoners taken as slaves are emasculated, instructed, and sold young, for 80 ducats, to guard their women, and for managing business. They are rather fair than black. (See *Marsden's Marco Polo*, p. 452. *Wars and Sports*, p. 265.)

The kingdom of East Bengalla, the capital of which stood on the east shore of the mouth of the Ganges, but is now submerged (described in *Wars and Sports*, ch. vii.) was conquered by Kublai in 1272, and sent the tribute in ships to Fokein. As the writer of these notes lived many years at Dacca, on the west bank of the river, he is enabled to give some identifications from personal knowledge.

The American Indians suspend themselves by the arms, legs, or sides, to show their devotion. A boy drew two buffalos' heads a few hundred yards by cords fixed in the fleshy part of his sides. (*Brackenridge, Missouri*, 160.)—*Note.* The writer found one of his own servants, a torch-bearer, suspended by a hook through the flesh of his back, (to better his condition in the next life, he said.) He has seen the Hindoos run along with a tightly-stretched cord, fastened to posts, inserted in the flesh of each side; these were the shoemaker cast.

The American Indians use golden thread; they have shoes of hart skin, with white soles, and sewed with golden wire, with a blue and white stone of looking-glass. (*Peter Martyr, Dec.* iv. ch. ix.)—*Note.* These describe the well-known slippers of India; the writer possesses a pair.

The eating of fire, swallowing daggers, raising the dead, and other tricks, have been witnessed by many, and related by those who were deceived by their own credulity and the sleight of the juggler. (*Remarks on the Ind. of N. Amer.* p. 5.)—*Note.* A Calmuc must prove his innocence by carrying a red-hot hatchet or bit of iron, on the ends of his fingers, several toises distance. I am told that many of them perform the ordeal so adroitly as not to burn themselves. (*Pallas*, i. 533)

The fire and dagger tricks have been exhibited in England. The writer saw the Indians at Madras *swallow* long daggers, as it is called, but drew them back;—he was told that children from early age were accustomed to put blunt sticks down their throats, to train their stomachs. Resuscitating the *dead* is a common trick among the Lamas. (*De Guignes*, ii. 236.) Erlic Han has the power to raise the *dead;* it is from them that they receive what knowledge they have of hell and future existence. (*Pallas*, vol. i. 554.)

The Calmucs burn only the bodies of their chief clergy, lamas, and princes. The Prince Oudon married a *Turcoman* woman who insisted on being buried. Some are buried naked, leaning on one arm, as if reposing, their heads towards the west. A stake is planted at each corner of the grave, with a small flag of blue cloth. Some are thrown into the water, others carried into the woods. Some are buried under a heap of stones. (*Pallas*, i. 574.)

Some historians tell us that the priests in the great temple at Mexico amounted to five thousand; four hundred were in the service of Tezcatzontatl alone. (*Clavigero*, i. 270.)—*Note*. There were five thousand astrologers in the court of the Grand Khan Kublai, at Pekin. We must suppose that priests of every description were adepts in the occult art. (*Marco Polo, by Marsden*, p. 377, note 717). On the establishment of Teeshoo Laomboo, in Thibet, there were three thousand seven hundred gylongs for the performance of daily service in the temple. (*Rees's Cyc., Lama.*) (From this quarter, Assam, the writer supposes Montezuma to be derived; he wore *golden shoes*, a mitre such as is in use by the Lamas;) and his reception of Cortez was quite in the Mogul style. (*Conq. of Mex.* p. 326.)

Thirteen hundred sweet sounding little bells were in the booty at Darien.—*Peter Martyr, Hak.* iv. 647. *Note*. The Grand Khan Kublai sent an officer to take possession of the city of Mien (the old capital of Ava). There were two marble pyramidal towers, ten paces high, terminated with a ball, around which were suspended small bells of gold and silver, which sounded when put in motion by the wind. The officer was accompanied by numerous jugglers, and he found many elephants.—*Marsden's Marco Polo*, p. 449.

The Missouris are divided into bands, the pheasant, bear, buffalo, elk, dog; the latter is the bravest in war; (*Brackenridge, Journey to the Missouri*, 1816, p. 155); the eagle, hawk, beaver, and from all beasts, fowls, and fishes.—(*Remarks on the Ind. of N. Amer.* Boston, 1826, p. 13.) The juggler or priest names the dog or animal which is to be adored, and when it dies, they mourn till another brute is chosen as their

mortal deity.—(*M. de la Salle*, p.268.) *Note.* The Calmucs give to the new-born the name of the first person or animal they meet. Among the higher orders the name is chosen by their priests. The mothers follow their ordinary occupations two days after child-birth.—(*Pallas*, vol. i. p. 570, 571).

"In person, manners, customs, habits, opinions, traditions, religious notions, systems of education, the Indians are essentially the same people: the forms of their language are almost identical."—*Remarks on the Ind. of N. Amer.* p. 37. A number of them put rings into a hole perforated in the gristle of the nose, and lengthen their ears two or three inches by cutting them and hanging pieces of lead when they are very young.—(*Michaux's Travels*, p. 269.) *Note.* The ears of the Calmucs are enormous.—(*Pallas*, iv. 497.) The Garrows, near Assam, lengthen their ears by a great weight of brass rings. The Calmuc Idol, *Aiouschi*, has her ears stretched in the manner of a loop, as described, *Chappe D'Auteroche*, vol. i. Plate XXII.

The Peguans pull out the hairs of their faces with little *pinsons* made for that purpose.—*Hakluyt*, ii. 262.

The Calmucs retain two small mustachios, and pluck out their beards, and the hair from their bodies. They shave the rest of the head, leaving a small tuft at top.—(*Pallas*, iv. 498, 501.) The ring in the nose is very common in several places in Asia.

Many Indians of America have a singular contrivance to indicate the death of a person without an explicit declaration of the fact.—(*Remarks on the N. Amer. Ind.* p. 32.) *Note.* When a Samoyede is dead, his name must never again be pronounced, except by circumlocution.—(*Pallas*, iv. 101.)

The Tartars eat dogs, rats, leopards, mice, and all other beasts, except swine.—(*Sir J. Maundeville.*) The Mugs, or Tartars of Aracan, eat every kind of reptile *. Some American Indians also eat such food.

There can remain little or rather no doubt but that the original population of America is derived, almost, if not entirely, from Asia, and that the mass of the people are Turks, Mongols, Cal-

* These Mugs flatten the foreheads of their infants with a plate of lead. *Rees's Cyc.*, "*Arracan.*" They are Tartar-Moguls, and were subjects of Kublai.

mucs, and Siberians. Tartar is a name of no definite application to any tribe. Before Genghis Khan's reign they were *all* called *Turks*. The *Chinese* call all the *Turkish* tribes* *Tartars*.

The *Mandshurs* are said to be Moguls, so called from *Mansueu* Khan, great-grandfather to Kang-hi, the late Emperor of China†. Mongols, Calmucs, Turks, and Turcomans are all confounded in most histories by the name of Tartars‡. Turquestan, Cashgar, Calmuckia, and Mongolia comprise the fertile countries between lake Aral and the river Amoor, and that is the region which has ever been the head-quarters of all the powerful Asiatic conquerors, and it is to them that we must look from the earliest ages for the fugitives that have peopled America. Calmuckia was, about the year 1720, invaded by 300,000 Chinese troops, commanded by the emperor's best general, who was his fourteenth son. The Contaish, or prince of the Calmucs, who can bring into the field 100,000 excellent cavalry, defeated them. Mr. Bell calls him the Great Khan of Tartary, and describes him as a man of sense, affable, and strictly punctual to his word§. This is the exact theatre of war between the Chinese and the Tartars at this period, in 1828‖. The Calmucs are called Dsongari, in

* Respecting Turks, Turcomans, and Turquestan, see *Marsden's Marco Polo*, p 45, 154. Several Persian monarchs have been Turcomans.—See *Harris's Voyages*, ii 907. In the work called the Kuzzilbash (*Literary Gazette, March* 1, 1828.) the Turcomans are described with broad features and little angular eyes. If this be meant as a real description, it proves the difficulty of attaining accuracy on this subject, as Bajazet, the *Turkish* emperor, is, in Timur's letter to him, called a Turcoman.—*Sherifeddin*, ii. 148. The Turks of Constantinople are now a medley of Turks, Saracens, and Arabs.

† Abul Ghazi, notes, vol. ii 384, 387, 429. A daughter of the Emperor Kublai was married to the King of Korea, and received Kublai's seal as his son-in-law.—*Du Halde*, ii. 379. See notes to *Abul Ghazi*, p. 511.

‡ Levesque, Hist. de Russie, vol. vii. 191, 270.

§ Bell of Antermony, Journey to Pekin, 1720. Wars and Sports of the Mongols, p. 101. In the year 1811, one Bagh van Ho declared himself King and Priest of Tartary, and with 60,000 Mogul and other troops menaced and alarmed the Chinese dynasty. To show the Chinese governor of Nayman the devotedness of his followers, one hundred of them, by his command, stabbed themselves to the heart in the governor's presence. His manners were courteous, and he spoke four languages—*Univ. Mag. Oct.* 1811. This shows the uncertainty of history regarding these regions: the Abbé Chappe asserts, that these people were all destroyed or dispersed by the Chinese in 1757. See vol. i. 295.

‖ According to Pallas, vol. i. p. 495, "The Mongols, Buriats, and Calmucs may be considered as the same in person, manners, and rustic economy." When the Chinese ambassadors passed through Siberia, they requested permission of Colonel

Abul Ghazi, ii. 429; Soongars, by *Pallas*, i. 494; Zungores, by *Chappe*, i. 308. By themselves and the Chinese they are named Eluths, or Aleouths*.

The Turks and the Mongols both conquered up to the Arctic sea: the first have named Yakutsk, *Northern Turquestan*, and the emperor Kublai sent to the mouth of the Lena always for his falcons (he had 10,000 falconers). These events, and the accidental blowing away of fields of ice with the walrus (there called mammoth) fishermen upon them, over Behring's Straits, as described by the Russian Chancellor of Siberia, Muschkin Puschkin†, have undoubtedly furnished America with many Siberians. These fisheries, for the sake of the valuable ivory tusks of the walrus, are known in history twenty-three centuries.—(*Wars and Sports*, ch. xvi.) With respect to the languages recognised in America, of 170 words, the roots of which are the same, 115 are Mongol, Mandshur, Tungouse, Samoyede, and Tschoud: 55 are Celtic, Biscayan, Coptic, or Congo‡; that is, 55 Spanish or African; and not one negro was found by the Spaniards at the conquest. "The North American Indians have a kind of language by signs; it has much analogy with such signs used by Chinese, as described by Sir G. Staunton."—(*W. Dunbar, of Natches, Trans. of Amer. Phil. Soc.* vol. vi. p. 1.) The 'History of the Five Indian Nations§,' depending on New York, represents, in a remarkable manner, a correct description of the northern Asiatics.

Kamfer, governor of Jenesai, to visit *the tombs of their ancestors* near that city.—(*Wars and Sports*, p 216.)

It is related in the news (1828) from China, that the rebel in Tartary lays claim to the throne of Pekin. As the present Mandshur emperors are probably descended from the *daughter* of Kublai, it appears likely that the Contaish may be descended, in the *male* line, from the emperor who was expelled from China in 1369, and thereon founds his claim to the Chinese crown. Professor Ledebuhr was, in 1826, on the banks of the Tchonga, and visited the tents of the Calmuc, Saisan-Mongol, not far from the first Chinese post.—*Athenæum*, *Feb.* 29, 1828, p 171.

* Sir R. Ker Porter's Travels in Georgia, Persia, &c. I 474 (*Du Halde*, ii. 257.)

† Father Avril's Travels, p. 176. Wars and Sports of the Mongols, ch. xviii.

‡ Humboldt, Researches, i. 20.

§ By the Honourable Cadwallader Colden, Surveyor-General of New York, 2 vols. London, 1755. "The five nations (says he) are a poor, and generally called, barbarous people, bred under the darkest ignorance; and yet a bright and noble genius shines through these black clouds. None of the greatest Roman heroes have shown a greater love for their country, or a greater contempt of death, than these people, called barbarians, have done, when liberty came in competition. These noble virtues are sullied by that cruel passion, revenge, which they think it not only lawful, but

From all that I have heard and read of the Canadians, says Bell of Antermony, there is no nation in the world which they resemble so much as the Tungousians: their *wampum* is exactly the quipos of the Peruvians*. Up to the date of 1283, the year of the Japan invasion, there is not any evidence of any of the Mongol *people* having embraced Mahometanism. Hulacou, Kublai's brother, destroyed the race of the Abbasside Califfs in 1258: his son Ahmed, who came to the throne of Persia in 1281, is said to have become a Mahometan†. Choja Rashid, of Casbin, asserts, that Cazan Khan (great-grandson of Hulacou), who died in 1303, was the *first Mogul* who adopted that belief‡.

Quails are *very frequently* mentioned in the religious ceremonies of the Peruvians and Mexicans, and they were not allowed by the Moguls in Asia, to be killed§. "In the country of the Moguls," says Du Halde, ii. 249, "the number of quails is incredible; they fly about without fear even between our horses' legs."

Scalping and exhibiting the skulls of prisoners have been practised by the Scythians from the earliest times‖. The wandering Americans in general scalp, but the Inca Peruvians

honourable to exert, without mercy, on their country's enemies; and for this only it is that they can deserve the name of barbarians."—*Dedication.* This is an exact picture of Mongols. "*Vanquished, they ask no favour, vanquishing they show no compassion.*"—*Hakluyt*, vol. i. p 21. The speech of Sarpedon to Glaucus would apply to the Indians:

Could the declining of this fate, O friend!
Our life to immortality extend:—
But since, alas! ignoble age must come,
Disease and death's inexorable doom:
The life which others pay, let us bestow,
And give to fame what we to nature owe;
Brave, though we fall, and honour'd if we live,
Or let us glory gain, or glory give.

Nor is it impossible that the Trojans were *Turks*; Oguz Khan conquered Armenia, Tangut, &c., and was, probably, not the first Turkish hero.—See *Abul Ghazi*, ii. ch. 2 The *Macrocephali* were in Asia Minor, (Pliny); and some authors think that the Turks are derived from the Trojans, (*Purchas*, vol. v. 279,) which is not probable. *Centaurs* are *now* in Oguz's country. "The Tungouses, without holding the bridle, ride their horses at the utmost speed, shooting their arrows before and behind them with truly surprising skill."—(*Pallas*, iv. 310)

* Journey to Pekin, p. 170.

† Petit de la Croix, Life of Genghis, p. 403.

‡ Abul Ghazi, i. 29.

§ M. Polo, p. 340.

‖ Herodotus, Melpomene, lxiv.; and see the plates in Strahlenberg, which prove scalping in Tartary.

did not practise either that or exhibiting of skulls. The Mexicans had to contend with powerful warriors, and both customs were found among them.

The Incas were undoubtedly of the imperial blood of Genghis Khan. Montezuma's ancestors were Moguls, but not of the royal line; this is evident from the awe and reverence with which he mentions the *mighty Lord*, with whom he arrived in *ships* from a far distant land *. It appears clearly by Clavigero, b. ii. and others †, that human *sacrifices* were not practised in Anahuac till the year 1317, in which the Aztecs (who had arrived with the seven tribes in 1178) introduced this horror, instead of killing the prisoners when captured. The first Aztecs were slaves to a petty sovereign, but strong from their numbers and valour ‡. The other Aztecs who arrived in *ships* were still at Culiacan, on the Gulf of California; but they advanced in 1324, threw up intrenchments, and founded Tenochtitlan, which was *subsequently* named Mexico §. The following is a confirmation of the truth of this statement. In reproaching the emperor for permitting human sacrifices, Cortez said, by his interpreters, "It is decreed and established by a law from my king, whom ye confess to derive his descent from him who brought your ancestors to these countries, that whosoever smiteth male or female with the sword, should die the death. Montezuma, with a pale countenance and trembling heart, replied, Hearken, O Cortez! the ceremonies of sacrifices, left us by tradition from our ancestors, we have hitherto exercised; but seeing that we have erred, and that it is displeasing to our king, we are greatly delighted to hear it, provided we may persuade the people thereunto. *Our ancestors who were left here, found these rites to be observed by the inhabitants*, so that we have followed the custom of our fathers-in-law and our wives, and you are not to wonder that

* Hakluyt, iv. p. 558.

† Humboldt's Researches, vol. i. p. 216.

‡ Clavigero, vol i p. 118, who, for want of knowing this double arrival of Aztecs, has, as he acknowledges, found it quite impossible to reconcile the history with known facts. Other authorities have been equally perplexed with this part of the history.

§ Conquest by Monguls, ch. vii. It is said, that ambassadors on *elephants* had been sent.—*Clavigero*, lxxviii.

‖ Charles V.

we fell into these errors, if they be errors. Give us a law, and we will endeavour to embrace it with all our power*." This is a clear acknowledgment that Mexico was founded after 1317. The Mongols in Asia raise pyramids or pillars of the skulls of the slain, upon the field of victory. The Persians have this horrid custom. "The *pillars are built of brick and lime, and into niches were thrust the heads* of about one thousand Russians, placed round the pillars in rows †." The Mexican Indians in Anahuac had pyramids of great dimensions for their religious rites as fire-worshippers; and it was in these structures that *they* exhibited the skulls. "The idols and furniture of their temples were kept in three halls, so large as to astonish the Spaniards. One was a great prison like a cage, in which they lodged the idols taken from their enemies. In other buildings of this kind, they preserved the heads of the sacrificed captives; in others, the heads were arranged upon poles, or fixed against the walls. The greatest of these buildings was a prodigious rampart of earth, longer than broad, in the form of a truncated pyramid, 154 feet long at the base; the ascent to the plain at top was by thirty stairs. Upon this plain were erected, four feet asunder, seventy very long beams bored from top to bottom; sticks were passed through these holes, from one beam to another, and upon them heads were strung. There was a head between every stone upon the stairs. At each end of this edifice, there was *a tower which appeared to have been made only of skulls and lime.* The skulls of ordinary victims were stripped of the *scalp*, but those of great warriors they preserved with the skin, and beard, and hair entire. There were 136,000 heads‡. The Chichemecans

* Peter Martyr, *Decade* v.—*Hakluyt*, iv. p. 567.

† See Alexander's Travels from India to England in 1826.

‡ *Clavigero*, vol. i. p. 266. "Timur ordered 120 *towers* to be made for the skulls of 90,000 of the slain, at Bagdat in the year 1401." Shereteddin, b. v. ch. xxxii. Thus this barbarian custom was in practice at the same epoch in Asia and Mexico, by Mongols in each country. The Mongols in Asia, who had so recently become Mahomedans, retained this disgusting part of their former idolatry. The terrific Calmuc idols Erlik-Han and Jamandaga (in *Chappe*, vol. i.) are crowned and hung round with skulls and heads with hair on them in great numbers. Genghis killed his prisoners immediately. Montezuma justified to Cortez the sacrificing them to their gods instead of killing them when captured.—(*Clavigero*, ii. p. 445). The Peruvians did not sacrifice men, nor probably would the Mexicans have introduced that custom, had it not been established by the numerous Aztecs who had arrived in 1178, thirty-five years before Genghis conquered Cathay and Korea. From that

have certain temples covered with straw, with small round windows full of skulls of men. Before their temple is a round ditch, the brim of which is encompassed by a serpent of gold, silver, and other metals mixed, with his tail in his mouth.—(*Hakluyt*, iii. 363).

It is probable, that the Mahomedan Mongols and Tartars, would have avoided any similitude to the shape of the contemned Guebres' places of worship, although policy might induce them to exhibit heads in skull-towers.

"I perceived a mound, or conical hill," says Sir R. K. Porter, (vol. i., p. 298) "at a little distance from the road, with uneven ground about its base, and the *vestiges of a stone building;* it was of greater altitude than any I had seen. I inquired of Abbas Mirza, by whose side I had the honor to be riding, what he thought of the origin of those heaps of earth? He said, that he supposed they were the work of the fire-worshippers of former ages, who usually erected their altars upon high places. It stood just in the position where such a pyramidal height may have been required, and his royal highness's suggestion was very probable; *each village having then its high place,* as it may now have its little oratory of prayer for Mahomedans."

Near Ispahan, there is a high conical hill,—it is called *Attush Kou,* or Fire-hill; there are *fragments of buildings on its summit.* It stands close to the quarter where the Guebres dwelt, particularly those who followed the arms of Mahmoud the Afghan, A. D. 997, who gave them a mart still called Guebrabad. Upon such hills was the sun adored; and sometimes in caverns, where fire was used by the followers of Zoroaster, in place of the god of day*. "At Hansi Hisar†, 126 miles to the W. N. W. from Delhi, there is a construction in the shape of the frustum of a pyramid, eighty to one hundred

period to the invasion of Japan was seventy years; during which, the Chinese Mongols had become more humane and civilized; they had conquered all the continent of Asia, except Hindostan and Arabia. They had made desperate attempts on Hindostan by Chitta, Thibet, Moultan, Outch, and the mouth of the Indus. On one of these expeditions, Dova sent 200,000 cavalry, but the Afghans were still more powerful, and Hindostan resisted them till Timur's invasion and Baber's conquest in 1525.—*Wars and Sports*, ch. ii.

* Sir R. K. Porter's Travels, vol. i. p. 437. vol. ii. p. 46, 495; D'Herbelot, "Atesch."

† In the country of the Turcomans, Hainsa is the name of a chief, and Hisar is a territory.—*Abul Ghazi*, p. 9., ch. iii.

feet high, artificially raised; the exterior slope on each side is faced with brick, forming an angle of seventy-two degrees with the horizon; still the *terre-pleine* at top is considerable. If ever fire-worship had been prevalent on those plains, I would rather say, that it had the appearance of a grand fire-temple, than a place intended for defence. There is an inscription to commemorate a victory by Prithwaraja over the race of Doda*." The comments of Capt. Tod tend to prove that the Getæ have frequently invaded India, and of this fact there can be no doubt; for we find that when Timur was in India in 1398, after he had ruined Batnir, on the 30th of November; he, on the 4th of December, encamped in a country inhabited by *Getes*, who had by force of arms made themselves masters of it a long time; they robbed and murdered, and had not the least mark of religion; these wretches hid themselves in woods of trees full of prickles, but the emperor sent a regiment under two lords, who put to the sword near 2000, and loaded others with chains†." Thus we find Getes at the very place mentioned by Captain Tod. It did not suit Timur's policy to allow that even the Patans were of the *exact* true faith, "although it was written on their coins." The emirs, however, did not countenance this invasion; Timur, therefore, proposed to seek the sign in the Koran, and they all assented. This sacred verse came forth: "*O Prophet! fight with the infidels and unbelievers.*" The emirs hung down their heads and were silent. "I was loth to desist, and my heart was grieved; but although they had angered me, as they were unanimous at last, I regarded it not‡."

"Oguz Khan conquered Cabul, Cashmir, Tangut, and Cara Kitay, by lake Mohill, between Kitay and the Indies, where the people are as black as Indians: drawing south, he found upon the sea coast among the mountains, a very warlike people, who had a Khan called *Itburac*, who with a good army constrained him to go back, and post himself for security between two great rivers §. These people were probably of

* Captain Tod's Comments on a Sanscrit inscription, relative to the last Hindoo King of Delhi.—*Transactions of the Royal Asiatic Society*, vol. i. p. 1.

† Sherefeddin, vol. ii. p. 46. ‡ Timur's Institutes, p. 131.

§ *Abul Ghazi*, part ii. ch. ii. There has always been communication with Ava

Assam and Burmah. Oguz lived about seven centuries before the Christian era, his residence was in Siberia in summer; and in winter by the Altai mountains. He is the restorer of the worship of the Sun, and Genghis claims descent from him. Thus in all northern Asia, these temples for fire as the emblem of the Sun, may be found. When Genghis was on the banks of the Oxus, he conversed with the wise men of Balc, who told him that Zoroaster had been king of their country, and that he alone, of all mankind, laughed when he was born; that he was called king of the Magi; and that they had a temple in every province, magnificent remains of which were still to be seen.—*De la Croix*, p. 339. These were *Mahometans* who conversed with Genghis.

The cities on the Kerlon, says Du Halde, are of no great antiquity, being built by the Moguls, *after the reigns of Mango and his brother Kublai.* There are ruins of their cities in above twenty different places: at Para Hotun there are *two pyramids in ruins* *. When the *Turks* overthrew the Nogais (Mongols) at Perecop, they erected some of the stone-forts with the skulls of the slain †.

The custom of the Assamese and Burmans to encamp in stockades is well known. The same was practised in America. Throughout the valley of the Mississippi there are traces of a considerable population, and of two distinct races or periods. The appearances of fortifications, which have been attributed to the *Welsh*,‡ are only traces of *palisadoed* towns or vil-

from Tartary. They send from Samarcand to Ca-ubi in Pegu for their tiger skins.—*Vincent le Blanc*, p. 159. "Timur reviewed his troops, April 9th, 1391. He ordered them to be placed in Tomans and squadrons, every soldier with his war club, lance, leathern buckler, &c., and that their horses should be covered with tiger skins".—*Sherefeddin*, vol. i. p. 356. This tremendous army defeated the Emperor of Capshac, in the north of Russia near the Volga.—*Wars and Sports*, p. 118.

* *Du Halde*, ii. 250, 251. The pyramids in ruins cannot be supposed to mean such pillars as Mr. Alexander describes. It is fair to conjecture that, as these pyramids at Para-Hotun are called *ruins*, and as those mentioned by Sir R. Porter had *vestiges of stone building at the base and top*, they have originally been similar to those in Anahuac and Mexico. The Aztecs found a large population, and were, therefore, obliged to continue the indulgence of their exact customs and manners, as Montezuma's race were not adored and obeyed like the Incas, as *Children of the Sun.* Thus we see also that the Mongols at *the same epoch* built pyramids in their native land Para-Hotun, and Montezuma himself built one at Mexico. The Incas among the ruder southern tribes adopted more elegance, at their will.

† *Purchas*, iii. 633.

‡ Madoc lived A. D. 1170.

lages. The Arikara and Mandan villages are still *fortified* in this way. I think there must be traces of *five thousand* such places. The earth is thrown up a few feet, and pickets placed at the top. Some of them inclose a hundred acres. The barrows, or receptacles for the dead, may be classed with the palisadoed towns, and are more numerous. The tumuli, or mounds, are often met with, distant from any of the above. These are very ancient; the Indians have no traditions of their authors or purpose*. The old chief, Du Coin, told Mr. Rice Jones, that the mounds in the American bottom had been fortified by the Kaskaskias in their wars with the Iroquois. An old book, by Lafitau, a Jesuit, contains a plate in which a mound, fortified by palisades on the top, and large beams extending to the bottom, is assaulted by enemies. These tumuli are at the junction of all the considerable rivers, and best position for towns in fertile lands: there are about 3000, the smallest 20 feet high, and 100 in diameter at the base. They are found from the mouth of the Ohio to the Illinois river on the east; and on the west from the St. Francis to the Missouri. I am perfectly satisfied, says Mr. B., that cities as populous as ancient Mexico have existed in these parts. There are traces of two such cities near St. Louis, on the bank of the Cohokia. There are about 100 mounds in two groups: one of them nearly equal to the Egyptian Mycerinus, being 100 feet high, and 800 paces in circumference †. A description of it was published in the newspapers at St. Louis, but it attracted no notice. These mounds resemble the Teocalli in their position to the cardinal points; the large ones have, *like them, several stages*, and in every group there are also two much larger than the rest, which stand around symmetrically. The resemblance to those of New Spain, renders probable the existence of the same arts and customs. Solis tells us that every considerable place had a number of mounds, and from the description of the *Adoratorios*, they were destined probably to the

* The aversion of the Indians to giving information to Europeans, especially regarding their religion, and *tombs* in particular, is notorious. The *Tartars* of Asia never disturb the tombs, although they know of the wealth they contain.

† The pyramid of Mycerinus was 300 *feet* high, according to Herodotus, *Euterpe*, cxxxiv. On the subject of pyramids see the ingenious remarks in *Humboldt's Researches*, vol. i.

same purposes as the Mexican. This gave rise to the first discoverers having supposed that they had seen cities with numerous steeples. The four great cities in Mexico contained 2000 of these Teocalli. These platforms were the places to which the inhabitants fled when opposing Cortez, when, as De Solis describes, they appeared like a living hill. These works answered the three purposes of temples, tombs, and fortresses. Pieces of obsidian, or flint, are found in great quantities near them, as is the case with the Teocalli.* Some may be startled, says Mr. B., if I should say that the mound of Cohokia is as old as those of Egypt.* The Mexicans attribute theirs to the Toltecs or Olmecks, who probably *emigrated from the Mississippi.* I question whether, before the invention of the compass, gunpowder, and printing, there existed or could exist nations more civilised than the Mexicans and Peruvians. Was any thing in the old world superior to two roads from Quito to Cuzco*?—(Letter to Mr. Jefferson, from H. H. Brackenridge, Esq., Baton Rouge, 1813, in the *Trans. of the American Phil. Soc. Philadelphia,* 1818, vol. i. New Series.) There is nothing in the above extract to show any difference in the origin of these mounds, &c. from those of Asia and Mexico, nor to prove a greater antiquity than the Toltecs. The wandering hunting pursuits of these tribes would require them, in numerous places, to secure themselves from surprise by stockades, and to erect a place of worship during their residence, till the game was exhausted, and this would require years. But it is probable that there may have been more *towns* in this quarter besides Talomeco, which certainly proves a good degree of civilisation. The *Natches,* who appear to have accompanied the Mexicans and Peruvians, as they also arrived by *sea, and were nearly perishing when they discovered land* †, were, in habits and customs, similar to the Mexicans ‡. Of

* These immense works, or roads, were executed in the reign of Huayna Capac, who died A. D. 1527.—*Garcilasso de la Vega,* b. ix. ch. xiii. The road through the plains was exactly such as were made in Kublai's reign in China.—See *Marco Polo,* b. ii. ch. xxii.

† *Conquest by Mongols,* ch. vi.

‡ These remarks being chiefly regarding North America, the reader, who desires more information on the subject of tombs and pyramids of the Mongols, Calmucs, and Americans, is referred to *Humboldt's Researches,* vol. i. *Conquest of Peru, Mexico,* &c. by the Mongols, ch. v. viii. *Wars and Sports,* ch. v. *Abul*

the Natches, Dr. Robertson observes, "The ancient Persians, a people far superior in every respect, founded their religious system on similar principles. This surprising coincidence between two nations, in such different states of improvement, is one of the many singular and unaccountable circumstances in the history of human affairs." The two most philosophical and scientific writers on American history are Dr. Robertson and Baron Humboldt, and both of them are frequently surprised and puzzled with such close similitudes with Asia as the above. The Spanish authors, and those of the United States, are frequently out of humour with Dr. R. for underrating the civilisation of the ancient Americans, and whatever relates to the New World. There is the same comparative difference between Americans and such Asiatics as are best known in history, as existed in the Old World between the ancient Persians and the Scythians; and the arrivals of the Tartars in America in considerable numbers from 544 to 1283, the earliest and the latest dates recorded, are sufficient to account for everything of any importance that is yet known with regard to America.

Ghazi, and *Strahlenberg*. With respect to Peru, the following is new. "On the road to Potosi, I saw numerous Indian stone sepulchres, *oblong* in form, and ten or fifteen feet high; they appeared as far as the eye could reach, displaying their white heads, and looking like the tops of houses in an inhabited town." *Capt. Andrews' Journey from Buenos Ayres to Salta*, &c., 1827. In Siberia and Tartary the graves are of several shapes; there are *oblong*, triangular, of rough hewn stones, square freestones, and some of earth. Some are as high as houses, and placed so near together, and in such numbers, that at a distance they appear like a ridge of hills. The ambassadors of the Chinese Tartars, when they returned from their expedition to the Calmuc, Ajucki Khan, asked Col Kanifer at Jenesai, for permission to visit the graves of their *ancestors*, but were refused, as the tombs had been rifled and demolished.—(*Strahlenberg*, p. 365.) At Cæsaria, in Asia Minor, which was conquered by Octai, son and successor to Genghis Khan, there are 20,000 pyramidal tombs, supposed to be those of Tartars who fell in battle.—(*Abul Ghazi*, Note, p. 558.)

* There not being any *iron* tools in America, has induced many persons to withhold their belief of the perfection described of the buildings of the Peruvians and Mexicans. But this is no objection whatever, as the Japanese had the art of hardening copper to that degree, that they *preferred copper* tools to those made of *iron*, which they also possessed: (*Kæmpfer*, 109) and the Mexicans felled *immense* trees, and shaped them with copper-axes cunningly tempered.—*Peter Martyr, Hakluyt*, iv. 598, who says that some trees were a hundred feet long, and bigger than an ox, which he dare not mention, but that he had it from great authority affirmed before the senate.

Comparative History of America and Tartary.

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A. D. 544. The Toltecs, under *seven* leaders, were banished from their own country, Huehue*tlapallan* in the kingdom of Tollan, N. W. of *Mexico**. They tarried at several places on their journey, and did not reach Anahuac † till the year 670, where they founded the city of *Tula*, on the banks of a river, after the name of their native country‡. Their first king was Chalchiutlame, their last, Topil*tzin*. (*This is the first historical record known in the history of the whole of America.*) Quetzalcoatl, a white man with a long black beard, was the high priest of Tula; he was rich, and lived in palaces; he had silver and jewels. His laws were promulgated from the top of a hill by a crier with a loud voice. He went to Cholula, where the Toltecs raised a great eminence and built a sanctuary upon it; another was erected at Tula, and a temple was built upon it. His worship became general; he was the *god* of the *air*. The *Yucatans* boast that their nobles were descended from this saint. Tezcatlicopa appeared to this saint in the form of an old man, and told him that it was the will of the gods that he should be taken back to his kingdom of Tlapallan, and offered him a beverage which he drank and set out, remained twenty years at Cholula, and *suddenly disappeared* in the east, according to some, and others say he died §.

The Toltecs introduced the cultivation of grain, cotton, pepper, and fruits; they had the art of casting gold and silver into any form, and of cutting gems.

* *Clavigero* vol. ii. p. 226. *Humboldt's Researches*, vol. ii. p 249. The word *Mexico* was not used in America *till after the year* 1325, which the reader must especially bear in mind.

† The sublime vale of Mexico is so named.

‡ *Clavigero*, vol. i. p. 85.

§ Clavigero, vol. ii. p. 248. Humboldt, vol. ii. p. 248. also vol. i. pp. 169—173.

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A. D. 544 is the period when the total ruin of the dynasty of *Tsin* occasioned great commotions in the east of Asia.—*Humboldt*, vol. i. p. 170. Butezena, the first leader of the *modern* Turks, who first arose to fame about the year 545, resided in lat. 49° near the Irtish. He married a Chinese princess. The Chinese were tributary. Justinian's ambassadors to the Turks were feasted in tents with silk hangings. The royal seat, the cups, and vessels were gold. A bed of massy gold was raised upon four golden peacocks *. Admirable silver statues, dishes, and basons, were ostentatiously displayed in waggons. Their south boundary was the Oxus. They subdued the nations from the rising to the setting sun, said Disabel to the emperor Maurice, and who styled himself lord of the seven climates, master of the *seven races*. Their men and horses were now computed by millions.—*Gibbon*, ch. xlii.

"The river *Tula* joins the Orgon, and at length falls into lake Baikal; the Mongols speak of it with admiration. On the bank of this river there is the residence of a great Lama †."

The grand Khan of the Geougen resided on the banks of the Tula. In 520 his youngest brother *suddenly disappeared.* Tivan, a handsome sorceress, aged twenty

* The peacock was not found in America. Peter Martyr, in his accurate description of the turkey, calls it *peacock*, and he continues that name, often and without reference to his description; which may have deceived some persons on this subject.—*See Hakluyt*, vol. iv. p. 564.

The turkey was not known in the old world; the emperor Jehanghir, in his commentaries, describes one as an extraordinary curiosity. It may be noticed, also, that the writer never heard any positive proof that tobacco was used in Asia before the discovery of America. A wonderful fact, if so, considering its universal adoption.

† *Du Halde*, vol. ii. p. 251, *and map*, p. 236. In Arrowsmith's great map, the Tula is N. lat. 47°, E. lon. 107°; it is about 200 miles in length.

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Having observed in their own country, that the solar year exceeded the civil one about six hours, they regulated it by interposing the intercalary day once in the four years, and which they did more than one hundred years before the Christian era. They had a distinct knowledge of the deluge and of Babel*.

The Toltecs multiplied exceedingly, and had numerous large cities, but a drought of several years gave them a dreadful shock from famine and disease, and they emigrated to other countries. Some directed their course to *Yucatan,* some to *Guatemala,* and *other places,* and some families remained in the kingdom of Tula. Thus the Toltecan monarchy ended with the death of Topiltzin, A. D. 1052†.

Anahuac remained desolate till the arrival, in 1170, of a *great number* (reported a million) of Chichemecas, from Amaquemacan, where different monarchs had ruled

* Clavigero, vol. i. p. 86.
† Clavigero, vol. i. p. 89.

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years, declared that he had been carried to heaven; but on offering a sacrifice to the spirit of heaven, she caused him to appear, and he declared that he had been in heaven during his absence. The empress was delighted at regaining her son, and the emperor married the charming priestess, on whom was conferred the title of divine, and also that of Khatoun * or empress.—*D'Herbelot,* vol. iv. p. 89. *The Turks had been despised and enslaved by the Geougen.* Some of the Geougen sought refuge in China. The Turks demanded them, and the emperor was too much alarmed not to deliver them up, when they and their khan, about 3000, were instantly beheaded.—*Conquest by Mongols,* ch. vii.

The reader may judge of the probability of flight from warriors of this epoch. In the war against Justinian, the Huns dragged at their horses' heels 120,000 subjects of the Roman empire.

The Chinese have been acquainted with the length of the solar year, says Father Gaubil, consisting of 365 days and almost six hours, ever since more than one hundred and twenty years before Christ.—*Du Halde,* vol. ii. p. 230.

The Mongols and Tartars claim descent from Japhet.

In the year 1170, Caracorum was the head-quarters of the Keraits, who are *Turks.*—*De Guignes,* vol. iv. p. 3. Oungh was the Grand Khan. In 1154, Timougin (the future Genghis) was born, near lake Baikal. In 1156, his father being dead, he set up his standard, a horse's tail: his subjects revolted. In his fourteenth year, he married a relation of

* "*Aloo wontoowit,* in American language, means God above all. *Katun*atoowit is a compound, which means God, but we are ignorant of its elements."—*Remarks on the Indians of North America,* p. 28. Aloo, doubtless, is the Alla of Asia, and was used by the Mexicans and Incas in their religion. Turkan *Catun* was empress of Persia, A. D. 1220.—*Wars and Sports,* p. 30. Therefore, in America, it was probably, also, a feminine epithet for supremacy.

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their nation many years; they were under a sovereign and his chiefs, with entire submission. They lived on grain, fruits, and the spontaneous roots of the earth. They were clothed with the skins of wild beasts, armed with bows and arrows, and worshipped the sun. They had been eighteen months on their journey, and arrived at Tula by the same road as the Toltecs, and spoke the Toltec language. Their last king in Amaquemacan, divided his government between his two sons, Achcauhtli and Xolotl, who quarrelled. The latter emigrated to Anahuac, and took possession of the country. Xolotl was the first king, his son's name was Nopaltzin; they and the nobles intermarried with the remains of the Toltecs who had survived*.

In 1178 the *seven* tribes of Nahuatlaks arrived from Aztlan †, near Amaquemacan. They all spoke the Toltec language. They consisted of Sochemilcks, Chalcks, Tapanecks, Acolhuans, Tlahuicks, Tlascaltecs, Teochichimecs, and Aztecs. The Aztecs arrived at Tula in 1196, and at Chapoltepec in 1245 ‡.

* Clavigero, vol. i. p. 90, et seq. Humboldt, vol. ii. p. 251.

† Boturini says, that Aztlan is in Asia.—See Clav. i. 112.

‡ Clav. i. 96. Humboldt, ii. 251, 252. These Aztecs, who left Asia 105 years before those other Aztecs, who were with Montezuma's ancestors, are the cause of the confusion in history avowed by Clavigero. These, in 1178, were rude Tartars, when compared with the others from China in 1283. Northern China, or Cathay, was subdued by Genghis in 1218.

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Ounghkhan. He fought many battles, and was taken prisoner more than once, and escaped. In 1169, his wife was captured and sent to Oungh, as an extraordinary beauty, (the grandmother of Kublai and Mango,) but Oungh treated her with respect. Oungh was first named Togrul, but that being the name of a bird of ill omen, he changed it. Ounghkhan had more than one quarrel with his *brothers and cousins, some of whom he put to death.*—All these events are in the vicinity of the rivers Tula and Lena.—*Petis de la Croix, Life of Genghis Khan,* A. D. 1170.

The Kalkas are divided into *seven* tribes; their princes are descended from Genghis Khan, or his brothers; they live chiefly along the rivers *Tula*, Selingha, Kerlon, and Orkon. They pay blind obedience to the Grand Lama*. In 1174 Ouisonlougine, daughter of Oungh, fell in love with Timougin, and rejected Gemouca, Khan of Jagerat; she married Timougin, who became Oungh's prime minister. Gemouca raised a desperate conspiracy to ruin the Mogul Prince, and his father-in-law, Oungh. All the confederate emirs and Khans, hewing in pieces a horse, a wild ox, and a dog, said, "Hear, O God! O heaven! O earth! this oath that we swear against Oungh Khan and Timougin. If one of us spare them, and fail to keep his promise to ruin them, and assist their enemies against them, may he become as these beasts." Oungh Khan's army was attacked, defeated, and his capital taken. *The remains of his army retired to the mountains.* The Grand Khan escaped to the camp of Timougin.—(*Petis de la Croix,* A.D. 1177.) These were Keraits, *i. e.* Turks, who appear to have been

* Du Halde, ii. 250.

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After the *beginning* of the thirteenth century, three princes arrived with a great army of Acolhuans, natives of Teoacolhuacan, not very distant from Amaquemacan. They were named Acolhuatzin, Chiconquauhtli, and Tzontecomatl, of the most noble house of Citin: they were brothers and sons of a great lord, and were the most civilized of any since the Toltecs. The King of the Chechemecas, who was at Tescuco, was alarmed at so great a multitude of strangers: but they assured him that they came from a country a little distance only from his own native land, and had heard of his humanity, for which reason they desired to place themselves under his protection and dependence. The king felt his vanity flattered by their courtly demeanour and humility, and he gave his two daughters to the two eldest. The marriage rejoicings lasted sixty days, in which were combats with wild beasts, wrestling, running, and such exercises. From this union the kingdom of Acolhuacan was founded, and many of the Chechemacas *took to the woods and mountains* to resume their old habits of hunting, where they mixed with the barbarous Otomies *.

In 1317 the Aztecs, who were numerous, and slaves to the petty king of Colhuacan, a town near the lake, (frequently confounded with Acolhuacan,) instituted the first human sacrifice, which awed and disgusted the king, and he discharged his Aztec slaves †.

The author of "La Galerie Agréable du

* Clavigero, b. ii. p. 93—95.
† Clav. i. 118. Humboldt, i. 216.

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masters of Siberia from the sixth century till the rise of the Mongols under Genghis.

After the most bloody battle recorded in history, the Grand Khan, Oungh, remounted his throne in 1179. In 1192 Timougin's enemies inspiring Oungh with distrust, he retires. The Moguls refuse to pay tribute. They confederate, and present to Timougin, the *Topouz*, a short staff, or truncheon of authority, in 1201 *. The Moguls march, and the two great armies meet on a plain, called Tangut. The neighing of the horses, and the cries of the soldiers of these mighty hosts, "*obliged Heaven to shut its ear.*" Oungh Khan had forty thousand killed, and the best of the survivors went over to Timougin. The Grand Khan fled to the Khan of the Naimans, where he was beheaded. His son Sancoun went to Thibet, then to Cashgar; he returned to Thibet, and was put to death as a spy.

Timougin took possession of all the Grand Khan's dominions, treasures, and palaces. The assembly of Khans agreed to elect Timougin their emperor. He was led by seven lords to a throne placed upon a black felt carpet, proclaimed Grand Khan of all the Mogul nations, and they all bowed the knee nine times. Timougin promised to make their names known to all the earth, and in 1205 he took the title of Genghis, (the Greatest.)—*Petis de la Croix*, chaps. iv. and v.

Genghis died in 1226. Mango, his grandson, died in 1257, and was succeeded by his brother Kublai, who resided at Pekin, and died in 1294, aged 80. In the year 1280 the Mogul empire comprised *the continent of Asia, except Hindostan and Arabia.* The frontier was the Don, and all

* This is probably the same as that in the hand of each of the Incas, in their portraits; Vega names it a partisan.

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Monde,' says, that Ambassadors, upon elephants, were formerly sent to *Mexico:* (this name is used for all periods of history, and has created avowed confusion. See *Clav.* ii. 202, and i. xxviii*.)

In 1325 Mexico was founded, according to all authors and Clavigero, vol. i. 123: this author acknowledges the impossibility of reconciling the history regarding the nations of Anahuac, and that he is reduced to despair†.

In 1324 the Mexicans first arrived at the place of the city; they advanced from the gulf of California, having travelled many years, but were not contented. Their army had ten chiefs, named Tenuch, Occpalan, &c. They found the ground covered with briars, like woods; and in the water there was a rock, and a bush of tunal (opuntia), wherein was an eagle, and her haunt was full of bones and feathers of birds. Here they made themselves a strong city, defended with banks and walls, and called it Tenochtitlan, and afterwards they named it Mexico. Tenuch was selected as the chief of their senate. They subdued and made tributary the two towns of Colhuacan and Tenaincan.—(*Acosta in Purchas*, iii. p. 1066.)

Tenuch died in 1377, when Acamapich was elected *king*, and Montezuma was the ninth sovereign; he died in 1520.—(*Conquest by Mongols*, ch. vii.)

In Peru the Giants landed at Cape St. Helens, from large barks; they dug wells, caught fish with nets, and murdered the natives. Mango and his wife appeared at

* The elephant's bones, which have been found in North and South America, are upon the places, in general, about which there are traditions of conflicts with giants, the description of which is that of elephants; and the skeleton of one was found in a tomb in the city of Mexico, which had been built on purpose.—*Quarterly Journal of Science, Jan.* 1828, p. 359. *Conquest of Mexico and Peru by Mongols*, ch. x.

† Clavigero's theory is, that the Mexicans are from the populous North in *America*, and that the skeletons of elephants are human.

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Russia was tributary*. In 1272 Kublai had conquered Eastern Bengal, Ava, Pegu, Assam, &c. In the battle with the King of Bengal there were 1000 elephants, of which he captured above 200, and received elephants, henceforth, as a part of the tributes. Marco Polo relates that he had five thousand. From the year 1272 he always employed elephants in his wars. In 1280, in a desperate conflict by land and sea near Canton, the Chinese empire was wholly vanquished. Kublai resolved on the conquest of Japan. An immense fleet and army sailed from Kinsai and other ports in 1283. The Chinese history is confused and uncertain as to numbers. Du Halde says only three persons returned. The Japanese history relates, that in 1283 the Tatar general, Mooko†, appeared on the coast with 4000 sail and 240,000 troops; that their gods raised a storm, and destroyed all this reputed invincible armada‡. At this period Chinese ships for sea voyages had four masts, and 250 sailors§. The interior is divided into numerous small compartments and bulk heads, and are double planked, so that in case of a leak, or a blow from a whale, only one compartment is affected. The main and foresail are made of *mats*, and fold like a screen. The tackling and cables are made of *ratan cane, and the hards of the cocoa, called cairo; the ropes are of bamboo,* and as strong as hemp.

* In 1525 the Moguls conquered Hindostan. They had alarmed all Europe, and ravaged it to the shores of Dalmatia. If we add their conquests in America, we may, indeed, with truth, call this "*beyond all Greek, beyond all Roman fame.*"

† The writer supposes the first Inca to be the son of Kublai, whose brother's name was Mango, or Mongko, (spelt both ways by Du Halde), and the first Inca was named Manco, or Mango. It is worth remarking, that the Incas dined between eight and nine in the morning, (*Vega*, ii. 5.) and that Timur's dining hour was half after nine.—(*Sherefeddin*, i. 355.)

‡ Kæmpfer, p. 187.

§ Marco Polo sailed to the Persian gulf with fourteen such ships.—*Marsden's Ed., Introduction.*

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Lake Titiaca, called themselves Children of the Sun, but did not think proper to disclose from whence they came. Not a word of history is known previous to this event. Huayna Capac was the twelfth inca, and died in 1527. He left upwards of 200 children.—(*Conquest by Mongols*, ch. ii.) The father of Huayna left as many, and Pacha Cutec more than 300. These children were not legitimate as successors to the throne, but all were by right entitled to be named *Children of the Sun*, and their descendants also; we may therefore imagine how numerous they were, and that this circumstance accounts for what justly would appear absurd to the author of the "Remarks," p. 59, where it is said, from Du Pratz, that the Natches boasted of having "500 *suns* subordinate to the *chief sun*:" the latter was probably a legitimate.

The Natches arrived by *sea after a long voyage*.—(See *Pinkerton's Modern Geog.* ii. 664.) It is Mr. P.'s opinion that Africa is the country to be looked to on this subject. With respect to Bogota, Talomeco, Michuacan, &c., they are evidently people of the same race and customs, as has been described in the "*Conquest*, &c." ch. vi.

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With respect to the Mexicans and Peruvians, the identifications having been published, it is only necessary to add in this place, that the writer has received authentic communications from Colombia and Peru very recently, and from competent authorities, regarding the persons of the Indians being completely Mongol and Calmuc, and the costume exactly Chinese-Mongol in very particular instances in Bolivia; and thus their origin is placed beyond a doubt.

The history of China, that of Japan, Marsden's edition of the Travels of Marco Polo, Sir John Mandeville, Rubruquis, Carpin, and the invaluable labours of the two French authors De la Croix, are among the principal original authorities from which the identifications have been extracted.

The general character of the Indians of the Six Nations is that of undaunted courage and contempt of death; desolation marks their train. Those who show cowardice are forced to wear female attire. "A Creek warrior fixed his frowning eyes on the Cherokee chiefs, and said they had long ago been forced by his nation to wear the petticoat."—(*Bartram*, p. 484.) —The Delawares had put on petticoats also.—(*Yates and Moulton*, p. 32.)

Every Calmuc chief or soldier, for crimes or cowardice, is deprived of his arms, dressed as a woman, and led into the camp.—(*Pallas*, i. 530.)

Their assemblages, sometimes of eighty sachems, are conducted with order, decorum, and solemnity, surpassing that of feudal barons. The positions for their residences were chosen with great judgment for the purpose of future conquests, which were always the result of unity and

The former laws of the Calmucs would do honour to the most polished nations of Europe, who pretend to call these free nations of Asia barbarians.—(*Pallas*, i. 528.)

It is well known that the Mongols, Calmucs, and Turkish tribes (the conquerors

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design. War, with them, was an ungoverned by policy and system. They observed the highest respect to their chiefs.

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of China) answer this description of the conquerors of Mexico, Peru, Florida, &c. They are braver than can be imagined.—(See *Abul Ghazi*, 535.) The Calmucs have nearly the same language, customs, and religion (*Lamisme*) as their *brothers* the Moguls.—(*Pallas*, i. 533.)

There is but one God in heaven, and but one Lord upon earth, the shadow of God, say these people of their grand khans.—(*Wars and Sports*, p. 52.)

The men were employed in war and hunting; the domestic drudgery was the occupation of the women. The eloquence of the men is compared with that of Cicero or Demosthenes *.

Husbands are wholly to employ themselves with hunting and war, and trouble themselves with nothing else. (*Yassa or Mogul Law*, xvii. *P. de la Croix, Life of Genghis Khan*, p. 85.) Ostiacs make perfect slaves of their wives: they themselves do nothing but hunt and fish. The Tungooseans and Ostiacs tattoo their bodies, like the Americans. (*Pallas*, iv. 56, 61.)

They fulfil their engagements with the strictest regard to honour and truth †.

Those best acquainted with the Indians are unanimous on this subject ‡.

The Tartars, under Genghis, are lovers of truth, and would not even preserve their lives by a violation of it. (*Sir W. Jones, Discourse* v.) The Turks and Calmucs are well known to bear the same character.

They are said to have eaten the bodies of their enemies, sometimes with a view to excite fury, more than for appetite.

The custom of tasting the flesh or ears of their enemies existed in Asia in the fourteenth century. (*Sir John Mandeville*, p. 303.) The Mongols will eat it from necessity, and sometimes for pleasure. (*Purchas*, vol. v. 419.)

The names of the nations are, Mohawks Oneydoes, Onondagas, Cayugas, Senecas, Tuscaroras. Each nation is divided into three tribes, the Tortoise, the Bear,

There are fifteen tribes of Tunguses in Daouria (Genghis Khan's country) only. The Mongols call them *Mongo*. They differ little from the Buriat Mongols. (*Pallas*, iv. 335, 337.) There are ten tribes of Yakuts, Kangalas, *Menga*, &c. They offer sacrifices to an invisible God in Heaven, yet they have an idol with a monstrous head, eyes of coral, and a body like a bag. (*Strahlenberg*, p. 380.)

The *Sabatski* (dog) Tunguisi go naked in the summer, except a hair girdle a span

* See *Jefferson's Notes*, p. 270, 272.

† History, says Colden, vol. i. 34, cannot give an instance of a Christian king observing a treaty so strictly, for so long a time, as these *barbarians*, as they are called, have done. See also *Remarks on Ind. of N. Amer.* p. 7.

‡ An instance of rigid and heroic justice among these Indians, is recorded by the author of the "*Remarks*," p. 7, which could not be found in the most civilized country. It is highly to be applauded that the United States redeemed the man's life at their own expense.

AMERICAN HISTORY.

the Wolf. The French name them Iroquois; they denominate themselves *Mingoes*, and are esteemed as the Romans of America. "*The Turtle tribe claim the ascendancy, because their relation, the great tortoise, bears this great island upon his back.*" (*Yates*, p. 31.) The Hurons are of the same stock. The dominions of the Six nations are in latitude about 1200, in longitude 750 miles, in New York, the lakes, &c.

Ronoon means *people*. *Tiuhtuih* Ronoon is the nation so denominated *.

All the cantons have traditions that their ancestors are from the *West*. The numerous entrenchments, stockades, or palisades, encompassed with hedges were made four hundred years ago, by the Seneccas against the Westerns †. The Powhatans, who occupied the country from the sea-shore to the falls of the rivers, were powerful, and consisted of seven tribes, each tribe subdivided into clans. In 1607, from the sea coast to the mountains, and from Patowmac to the south water of James' River, there were above forty tribes. (See *Jefferson's Notes*, 127, 274.)

The Cat Indians, a Malay race, were exterminated by the Iroquois of the Tartar stock, says Dr. Mitchell. (*Messrs. Yates and Moulton's Hist. of New York*, p. iv. An excellent and useful work.)

* Huitziton was a person of great authority among the Aztecs, (in Asia,) and who, for some reason, not known, persuaded his countrymen to change their country. While he was thus meditating, a little bird was singing in a tree *tihui*, *tihui*, which, in their language, means *let us go*. "Do you hear that, friend Tecpaltzin?" said he: "it is the warning of some secret Divinity to leave this country and find another. These respectable persons drew the body of their nation (the other six tribes) over to their party. (*Clavigero*, vol. i. 112.) This relates to the Aztecs, who arrived in 1178, with six other tribes, by land. Ridiculous as this would appear in any other history, it is not unworthy of consideration in inquiries in America regarding tribes; any one of them ascertained among the Indians, will greatly facilitate further elucidations in history and chronology.

† The sketch of the History of the Six Nations is from a Discourse by the Hon. De Witt Clinton, a very valuable Essay, in the collec. of the Hist. Soc. of New York, vol. ii. 1814.

ASIATIC HISTORY.

broad. (*Notes to Abul Ghazi*, 637.) There were more than twenty tribes of Moguls. (See *Abul Ghazi*, ch. xiii. xiv.)

The Calmucs are composed of an infinite number of tribes. (*Abul G.* 538.)

The *wolf* is the banner of the *Turks*, (See this Journal, vol. v. 148.) Stone *Tortoises*, of great size, were found at Olougyourt, the capital of Keyuc, Great Mogul, A.D. 1245. (*Conq. of Peru, &c.* p. 179.) The late General Kyd had a highly-polished greenstone tortoise, which he told the writer he had brought from Northern Hindostan. "*The earth stands firm upon thy broad back, O Cesava! assuming the body of a tortoise: be victorious, O Heri, Lord of the Universe!*" (*Sir W. Jones on the Hindoos*, vol. i. 289.) This is, probably, what the author of the "Remarks" on Major Long's Expedition alludes to as the *Totem*, or armorial badge of the tribe: it is a religious distinction also among the Laplanders. Hyu is their God of wolves; Nyrke, of squirrel-hunting; Uko and Rowne are their Gods who command tempests, &c. *Olmack* is their nominative plural for *man*. (*Scheffer's Lapland*, pp. 22, 78.) An Ostiac swears fidelity to the Czar, by a *hatchet*, with which he has killed a *bear*. His hatchet is buried with him; also his knife, a horn of tobacco, and a model, in wood, of his flint and *briquet* to strike fire. (*Pallas*, iv. 75.) These, therefore, appear to be the arms of Turks, Moguls, and Siberians.

With respect to the earliest rude inhabitants of America, the general uniformity of the mass of the population justifies the conjecture, that they were from Tartary. Oguz the Turk, the Cæsar of Asia, resided near the source of the Tobol, it is supposed about B. C. 700. He and his successors probably caused the construction of the great wall of China, and those commotions may have given rise to emigrations to America. The fisheries at the mouth of the Lena and other rivers, for the valuable ivory tusks of the walrus, (called by the natives mammoth,) are mentioned in the Chinese history 2300 years ago; and it is conjectured by Russians, that the fishermen have sometimes been blown to America, upon fields of ice; the American *history* supports this assertion.—*Conquest of Mexico*, ch. xii. But the rise of the modern Turks in the sixth, and of the Moguls in the twelfth and thirteenth centuries produced the tremendous convulsions which have supplied the New World with the bulk of the inhabitants, and with all those among whom any considerable degree of civilization was found. There are two modes of influx of people, one by the islands, and across Behring's Straits, which consisted, probably, of masses of fugitives, who inhabited above the lat. of 40°; the other by sea*. In 1283, when Kublai personally governed the whole of China, all India beyond the Burrampooter, Thibet, Tangut, and about half of the eastern portion of Siberia, his nearest relations were (under his control) sovereigns of the rest of the continent of Asia, (Arabia excepted, and Hindostan, till Timur's invasion and Baber's conquest.) This will account for there being found some Malays, Chinese, white people in Chili †, and probably some, of slenderer form, resembling Lascars or Gypsies, from Bangalla, but these are very partial exceptions to the general mass. "The Moguls were illiterate at the epoch in question; Kublai having ordered letters to be invented for his nation, by a Thibetian, whom he rewarded with the dignity of Grand Lama. More than fifty dialects are spoken between Moscow and China, where the

* In estimating the number that may have arrived by sea, it must be considered, that chiefs of such superior civilization as those from China, would soon establish their command over similar people who had arrived by land before the Moguls conquered China.

† As mentioned in the valuable work of Messrs. Yates and Moulton; who give reports of a few Welsh, not wholly void of possibility, p. 45.

languages, like those of America, are in perpetual fluctuation." —*Sir William Jones*, vol. i. p. 59. This proves the difficulty of tracing events and history by their means. The picture-writing of the Mexicans, the *Quipos* and *Wampum* of the Peruvians and Canadians (of Chinese origin), and the calendar of the Toltecs, are what we are indebted to for the scanty existing chronology. All the eastern American Indians agree in their having come from the *west.*

It might have been expected that more particulars of the remembrance of the Old World would have been traced: but the Indian registers were, as far as possible, destroyed by the Spaniards; and the Indians hid the rest. Without an alphabet, little can be conveyed to posterity; and the buccaneers, in *thirty* years, had forgotten all traces of Christianity. (*Yates*, p. 53.) We must also recollect how little is generally known of Siberia, the country which has had so great a share in peopling America; and which had not been visited by the Russians till Yermac, the Cossac, a fugitive with 6000 followers, crossed the Ural mountains in 1577, eighty-five years after the discovery of the New World. Kamtschatka was not known till 1697. (*Levesque, Histoire de Russie*, iii. 119. viii. 35.)

Another difficulty in tracing the Indians by their features often arises by their intermarrying. In Asia, the Moguls and Calmucs both intermarried with the Turkish tribes, and it no doubt is the same in America. Thus the persons would be mixed in their features, colours, and the shaping of the heads.

The only signs of ancient architecture, of any importance, yet discovered, are the ruins of Tiahuanaca, near lake Titiaca, in Peru. There was a pyramid formed of terraces, a long wall of huge stones, a hall, forty-five by twenty-two feet, *grandes portes* of stone, and sculptures on stone of men and women, well executed; also two stone giants with garments that reached the ground, and caps on their heads. The buildings bear the appearance of never having been finished. (*Vega*, i. 236.) This is evidently Chinese-Tartar, and is, probably, derived from a Tartar invasion of Japan, in the year 799; the vessels of which are said to have been lost in a tempest, not a single person having returned to Asia *. The Toltecs arrived in Asia before

* *Thunberg's Res. and Conq. of Peru*, 73, 468.

Mahomet lived; the Mongols before any of them had embraced the Koran. The religions in America were those of the Magi; who worship the sun, and fire, as its emblem; Buddism, or that of the lamas, in Tibet; and Shamanism, such as exists in Siberia; all confirmatory of the origin of the Indians; they are all three magicians, *par excellence*, and the two first are astrologers*. It is a satisfactory circumstance that Baron Humboldt and all the most enlightened authors of Europe, and also of the United States of America, have leaned entirely to the Tartar origin; and it is presumed that very few exceptions will, with further assistance from the literature of the United States, be found to the possibility of tracing any one of the tribes of the Indians to the emigrants described in this essay. Those tribes who reside at the greatest distance from Europeans will be traced with least difficulty, by their features, religion, *totem*, and traditions. Thus, if they prove Calmucs, a reference to the best editions of Pallas and La Chappe (which contain so many plates of their gods) will reveal the satisfactory and full proof of what has hitherto puzzled the world. The Caribs are indubitably Mongols and Calmucs, and the Winnebagos are Turks; these premises will serve as a guide to other tribes. As for the *totem*, we find that the horse-tail and peacock (the *turkey* † being probably its substitute in America) are common to both Turks and Moguls; the wolf is decidedly Turkish; the tortoise is most likely Mogul. With regard to the arctic inhabitants, there can be little doubt but the Tschouds on one side, and the Laplanders and Samoyeds on the other, have supplied them, and they have remained in climates congenial with their habits. Those inhabitants who were in America at the arrival of the Toltecs are, probably, if at present distinct from the emigrants now mentioned, the most barbarous. In

* In the thirteenth century there were many Nestorians in the service of the Grand Khans at Caracorum. Every one was free to follow any religion. The mother of the Grand Khan Mango was a Christian, and Mango himself "was a gode christene man and baptised." (*Maundevile*, p. 276.) It is very remarkable that Mango Capac possessed a cross of crystalline jasper, and kept it in a sacred chamber of his palace, where it hung by a ring of gold or silver, which the Spaniards exchanged for a band of black velvet. The Incas did not adore it, but held it in great veneration. (*Garcilasso the Inca*, vol. i. p. 119.)

† It would be interesting to know why this bird was named *turkey*. The first was brought to England in 1524: in Johnson's Dictionary it is supposed from Turkey. The first eaten in France was at the nuptial feast of Charles IX. in 1570. The name in Hindostan is *Peru:* it was probably received first from that country.

this inquiry it may be held in mind that Turks were the *governors* of Tartary from the middle of the sixth century, till the Moguls arose to fame, in 1201.

The epochs of emigrations from the west to the east in America, have been determined by the arrival of the Toltecs from Asia; the famine in 1052; the influx from Asia of Chichemecas; of the seven tribes, &c.; and of the Mexicans. Add to this, their own political quarrels and the Spanish conquest; and, probably, all their traditions will be resolved by reference to those events. Thus it appears an irresistible truth that the Turks and Mongols are the conquerors of Asia and America; and ravaged Europe, to the shores of Dalmatia; one, among the numerous proofs, is the general use of words evidently derived from Allah and Halleluya, among the Toltecs, Mexicans, Peruvians, and many others in the New World, in their religious ceremonies, as if, maugre their own discords, in one chorus, around this splendid globe, in adoration of that "Great Spirit,"

> "*Whose Temple is all Space,*
> *Whose Altar Earth, Sea, Skies!*"

The following notes are added with respect to the bones of the elephant and mastodon, found in America, (in addition to ch. xi. in the "Conquest of Peru, Mexico, &c." and the "Remarks" in this Journal, No. IV. p. 350,) in order to prove the *historical* origin of those fossil remains.

By the river Genesee, in the Senecas' country, there is a spring which petrifies almost everything that obstructs it.—(*Yates and Moulton*, p. 15.)

At Arikara we found quantities of petrified wood lying about on the surface of the clay *hills*. I traced a whole tree, the stump still remaining three feet high, and four in diameter; the bark was in general decayed, but we could easily find the position of the trunk and branches as it had fallen. Near the Poncas village there are the remains of trees of enormous size perfectly turned to stone, and the trunks of tall trees may be seen and traced.—(*Brackenridge, Voyage up the Missouri*, 182, 230.)

At Badminton, in Gloucestershire, there is a spring that petrifies wood.—(*Camden*, i. 276.)

In the kingdom of Ava, Father Duchat has often seen trees standing in a river, whose bottom part, as far as covered with water, were true flint, and all above dry, and fit for firing.—(*Rees's Cyc. Wood; from Mem. Acad. Par.* 1692.) A petrifying quality is found in Tartary, Africa, and all over the globe, in water, earth, and sand.—*Phil. Trans.* No. 461, p. 325.

Those instances of the rapidity of the petrifying process, prove that the bones are not necessarily old because they happen to be (which is not often the case) what is termed *fossilized;* and the following will show what distant removals from their native haunts may take place from natural accidents.

We saw a huge buffalo standing at the edge of a bluff, and looking down on us. Long and matted wool hung over his head and shoulders; his body was smooth, and also his tail, except a tuft at the end; (the bonassus is named buffalo in America.) He eyed us with the terrific ferocity of a lion; at length he threw his head up, wheeled round, and trotted off.

When within a few miles of a point of the river, our ears were assailed by a murmuring noise, which, as we drew near, grew to a tremendous roaring, such as to deafen us. On landing, we discovered the grove crowded with buffalos, several thousands of them roaring and rushing on each other in furious battle. The earth trembled beneath their feet, and the grove was shaken. We discovered that a herd of males had broken in among a number of females, which caused this scene of horror and confusion. On the hills, in every direction, they appeared by thousands; we saw an immense herd at full speed at the distance of two miles, the sound of whose footsteps was like the rumbling of thunder. At the burning bluff we found enormous masses of pumice; lumps thrown into the river floated. Quantities of drift-wood descended, and thirty or forty drowned buffalos passed us every day.—(pp. 97, 100, 199, *Brackenridge, Voyage up the Missouri.*)

The Indians, according to Mr. Bullock, in his *Description of Cincinnati,* (published in 1827, p. xxvii.) have not forgotten the mammoth traditions. "An Indian of the Six Nations showed me some drawings of his own execution, representing the Indian history of his tribe. Among the rest was a drawing of the mammoth, which he informed me was so represented by

his fathers, in whose traditions it was stated more to resemble a hog than any other beast." The stomach of a mastodon was found in the county of Wythe, in Virginia, and the contents consisted of plants known in Virginia, on which the animal had fed.

Mr. Collinson had a grinder of the mastodon, from the Great Lick, on the Ohio, which weighed near four pounds, with as fine an enamel on it as if just taken out of the head of the beast.—*Phil. Trans.* lvii. 468.

In Guatemala some gigantic skeletons and a molar tooth were found, near a stockade where a chief with a Mogul name (Calel) opposed Alvarado, and who sent the presents customary with Moguls, gold and a mantle or dress.

Grotius says that the Peruvians were a Chinese colony; that the Spaniards found, at the entry of the Pacific ocean, after coming through the straits of Magellan, *the wrecks of Chinese vessels*. Captain Shaler, our intelligent Consul-General at Algiers, is well assured that a Chinese junk was wrecked on the north-west coast of America; some of the money of that country was found on board.—(*Yates and Moulton*, p. 68.)

Timur Khan, grandson of Kublai, (and the presumed *legitimate* brother of Mango Capac,) succeeded to the empire in 1294. His Chinese name was Ching-tsong. He had been viceroy of Eastern Bangalla, Ava, Yunan, and neighbouring regions. His residence was at Tali, in lat. 25°, on the confines of Yunan and Ava. From A.D. 1268 to 1301, civil war was perpetual against Siberia, which was invaded by 300,000 troops at *one* time, and numerous armies were maintained there for thirty years.—(*Wars and Sports*, ch. v.) When Marco Polo was in China, Kublai had 5000 elephants, and after 1272 always employed those animals in his wars.

Many bones of elephants, says Pallas, are found in several places on the banks of the Biroutch. A great number, and the skull of an elephant, were found in the bank opposite the house of the seigneur of Nagadkina, ten miles from Tchirikovo, a village remarkable for its fine breed of horses. A tusk was found in the most perfect state of preservation except the point. They say that near this village there are two *ancient*

entrenchments, round about which, on digging, they find many *human* bones. If such be the fact, it will be deemed a triumph by those who think the elephants' bones found in these northern regions are the remains of the beasts which accompanied the invading armies; but it is more natural to refer them to revolutions that have changed the face of our globe."—(*Pallas*, vol. i. p. 214.) Bereké, or Barka, grandson of Genghis Khan, resided at Bolgar, in this very neighbourhood, and was visited by Marco and Maffeo Polo. He was one of the most liberal of the Mogul princes; this place was 300 years in their possession.

"*Until the discovery and examination of the bones of the* mastodon, *naturalists had not ventured to believe that any kind or species of animals had ceased to inhabit the earth.*" —(*American Quarterly Review, March*, 1827, p. 97.)

"In Leicestershire, in a bed of coal, *ninety-seven yards* below the surface, the entire skeleton of a *man* was found imbedded. Indications of a former pit were discovered, and the body must have fallen in, and have been pressed in the loose coal by the falling sides and incumbent water."—(*Bakewell's Geology*, 1828, p.23.) With regard to *Werner's Theory*, Mr. Bakewell, in two instances, remarks, (p. 207, 408,) that it is scarcely possible for the human mind to invent a system more demonstratively repugnant to facts; and that men of distinguished talents have resigned their judgment to his authority. (See this *Journal*, No. IV. p. 353 and p. 357, regarding some bones of the mastodon, like those on the Ohio, of large and young ones, found on and near the surface of the ground, a few miles from the Irawaddy, in Ava, accompanied with others of the rhinoceros, long-nosed alligator of the Ganges, and some of an animal of the horse kind, not decomposed, and the animals had died there.)

Thus we find that neither the position in the earth, the state of the fossil bones, nor the countries in which they are found, offer any real objection to their *historical* origin. Those found in Ava are in the region of the prince who sent the invading armies to Siberia, and most probably supplied the elephants for the expedition to Japan: it has been shown that the Romans, with their 120 ships annually trading to India, had

the means of procuring tapirs from Sumatra, and no doubt mastodons from Pegu.—(*Conquest of Mexico, &c.* ch. xi.) There is, therefore, every human probability, if not certainty, that this famous beast, the cause of so many erroneous conjectures, and so much speculation, is in existence in Assam or Ava, or both. It is not a little remarkable that the first grinder brought from an elephant country, possessed in 1283 by the Moguls, should be that of a mastodon. Among the numerous proofs of the Chinese-Mogul conquests in America, is, " that the practice of binding the feet in infancy, as in China among some refined Tartars, is also found among the American Indians."—(*Yates and Moulton*, p. 64.)

Erratum, in our last Number, p. 152, line 8, *for* buskins, *read* sandals.

Contributions to Experimental Chemistry.

[Communicated by Mr. A. I. Walcker.]

On Silicate of Soda.—A boiling solution of caustic soda dissolves pure (precipitated and dried) silica very readily. If as much silica has been added as the liquid is capable of dissolving, the filtered solution, which reacts on test papers as an alkali, assumes, by evaporation, a more and more tenacious consistency. Being exsiccated at 242°, a pale yellowish mass remains of a perfect glossy transparency, and consisting of

Soda . .	5.351	(1 proportional)
Silica . .	20.797	(8 ditto.)
Water . .	19.350	
	100,000	

This substance attracts humidity from the atmosphere, and dissolves in water, though very slowly. Being heated to redness, it loses its water, leaving a white spongy mass, which, when heated before the blowpipe, requires an additional quantity of carbonate of soda to be fused into a globule. The spongy mass did not increase its weight by being exposed to the atmosphere for a few days. The solution of silica in caustic soda, diluted with sufficient water to make the weight of the silica amount to $\frac{1}{10}$th, $\frac{1}{20}$th, $\frac{1}{30}$th, $\frac{1}{40}$th of the liquid, being *very accurately* neutralized by sulphuric, muriatic, or acetic acid, is immediately converted into a more or less dense and perfectly

transparent jelly. With $\frac{1}{50}$th to $\frac{1}{100}$th of silica, the liquid became gelatinous after twelve hours. With $\frac{1}{500}$th of silica there was no precipitation of silica even after two days.

The smallest excess of acid prevents the precipitation of the silica, and solutions containing $\frac{1}{30}$th of their weight of silica, did not become precipitated after twenty-four hours. Even boiling could not effect the precipitation of the silica, nor could anything be separated from the liquids by filtration through very dense paper. A solution of silicate of soda, containing $\frac{1}{100}$th of silica, does not become precipitated by being supersaturated with carbonic acid gas; but if the carbonic acid is subsequently expelled, either by boiling, or by exposure to the atmosphere, the liquid congeals. When $\frac{1}{1000}$th of silica is present, neither boiling, nor exposure to the air, nor agitation, cause the precipitation of the silica. Sulphate and muriate of ammonia convert a solution containing $\frac{1}{100}$th of silica into a jelly in a few minutes. When the liquid contained $\frac{1}{5000}$th of silica, no immediate change was perceptible; but after twenty-four hours there was a flaky precipitate of silica, which was still observable when the silica amounted to $\frac{1}{1000}$th of the liquid.

The muriates of lime, magnesia, baryta, and strontia produce an immediate precipitate in a solution of silicate of soda, containing $\frac{1}{1000}$th of silica. With $\frac{1}{10,000}$th of silica no precipitate ensues.

If a solution of silicate of soda be gradually poured into a solution of perchloride of iron, the precipitate so produced is instantly redissolved, and some of the silica is only then separated when the solutions are too concentrated. If the solution of silicate of soda contain about $\frac{1}{50}$th of silica, no precipitation is perceptible; the colour of the solution of the perchloride becomes more intense, and after the mixture has been boiled, so much so, that one grain of the perchloride is able to colour 20,000 grains of water, distinctly yellow.

If the mixture contain but $\frac{3}{4}$ths proportional of silicate of soda (= six proportionals for every proportional, upon the whole less than twelve proportionals of silica for every proportional of perchloride of iron), it reacts on test-paper as an acid: ferrocyanate and sulpho-cyanate of potash, and tincture of galls, indicate the presence of iron. Sulphuretted hydrogen very

speedily renders the fluid colourless prior to ebullition; but, after boiling, a continued current of this gas is requisite to produce the same effect. If a solution of one proportional of chloride of iron be added to a cold solution of one and a half proportional of silicate of soda (in about forty proportionals of water), a gelatinous precipitate of silicate of iron is formed: if, however, the solutions be mixed together in the boiling state, no precipitation takes place. Ferro-cyanate and sulpho-cyanate of iron produce no change in this liquid. Sulphuretted hydrogen precipitates sulphuret of iron.

Caustic soda and carbonate of soda decompose this solution, as well as those containing less than one and a half proportional of the silicate, after some time: when the liquid is heated, decomposition takes place instantaneously. Ammonia reacts in a similar way. Silicate of soda added in excess produces no decomposition. A mixture of perchloride of iron and silicate of soda, slowly evaporated to dryness, leaves a red-brown mass of a vitreous fracture, and transparent at the edges.

Water being poured upon the mass, it splits into fragments with a crackling noise, and the water dissolves chloride of sodium and perchloride of iron, or silicate of soda, if either has been added in excess.

The washed silicate of iron yields a light brown-yellow powder; being boiled with muriatic acid, the silica is completely separated.

In a solution of proto-chloride of iron, containing $\frac{1}{1000}$th of the chloride, the silicate of soda produces instantly a greyish-green precipitate; and the limit where a change of colour is still perceptible, is arrived at when the solution contains $\frac{1}{2500}$th of the chloride, whilst the caustic soda still causes a very sensible change of colour in a solution containing $\frac{1}{30,000}$th of the chloride, when the diameter of the liquid is equal to $\frac{1}{2}$ inch. Persulphate of iron being mixed with a diluted solution of silicate of soda (containing $\frac{1}{30}$th of silica), the former being in excess, no precipitation of silica is produced; but the mixture becomes decomposed by boiling. With excess of silicate the mixture congeals after standing twenty-four hours.

In a solution of perchloride of mercury, which was copiously precipitated by caustic soda, the silicate did not produce any

precipitate. By evaporating, or by decomposing a more concentrated solution of the chloride, very small dark red crystals are obtained.

In the proto-nitrate of mercury the silicate of soda produces a white precipitate, which only becomes decomposed if heated with caustic alkali.

In the sulphate of manganese a white precipitate is formed.

A solution of nitrate of silver becomes yellowish without precipitation, whilst a solution of the same concentration was copiously precipitated by caustic soda. Nitrate of cobalt and protochloride of tin were not precipitated by the silicate, whilst caustic soda produced precipitates in solutions of the same degree of dilution. Perchloride of tin, chloride of zinc, and nitrate of copper are more copiously precipitated by the silicate of soda, than by the hydrate.

Silicate of potash bears an analogous relation to the perchloride of iron.

On the Separation of Lime from Magnesia.

The oxalates of ammonia and potash have of late been resorted to almost exclusively for this purpose, on account of their precipitating very diluted solutions of lime. Professor Pfaff states, that in a solution, containing $\frac{1}{40000}$ of chloride of lime, a precipitate is formed after a few minutes, and that the reaction is at its limit (after a few hours) when $\frac{1}{100000}$ of sulphate or muriate of lime are present in solution. Analysts have advised not to precipitate from a too concentrated or from a warm solution, and to avoid an excess of ammonia, in order to prevent the precipitation of the magnesia. I know not whether there have been any direct experiments to prove what influence magnesian salts have in modifying the delicacy of the oxalates as a test for lime: I have, therefore, endeavoured to examine this point by the following experiments:

Sulphate of lime and chloride of calcium dissolved with different proportions of sulphate of magnesia, or anhydrous muriate of magnesia, in water sufficient to raise the weight of the whole liquid to 2000 times that of the calcareous salts, gave the following results when precipitated by oxalate of ammonia or oxalate of potash.

When the calcareous salts amounted to 5 per cent. of the magnesian salts, oxalate of lime was instantly precipitated; but its quantity, after 24 hours, was only to be estimated at about ¼ of that which would have been precipitated without the presence of the magnesian salts.

With 2 per cent. of the calcareous salts, the precipitation of the oxalate of lime began after some minutes; and after 24 hours, the quantity of it appeared to be no more than about $\frac{1}{10}$ of that to be indicated by the re-agent.

With 1 per cent. there was nothing precipitated during the first hour, and the precipitate was very inconsiderable, even after 24 hours, especially in the solutions of muriate of lime and magnesia. Similar results were obtained when the salt of lime was $\frac{1}{16}$ or $\frac{1}{20}$ of the magnesian salt; and the whole weight of the solution amounted to 500 times the weight of the former.

The precipitates produced by oxalate of potash, were almost always more copious than those by oxalate of ammonia—a fact which has already been observed by M. Du Menil, who found the quantity of the precipitate by the former, to be to that by the latter, as 22.0 to 22.5.

The following experiments prove the analysis, by dissolving the sulphates in a solution of sulphate of lime, to give a more satisfactory result.

A solution, containing 0.4 grain of sulphate of lime, and 40 grains of sulphate of magnesia, was evaporated. The remainder being heated to redness, and dissolved in 300 grains of a solution of sulphate of lime (containing 0.002 of the sulphate) at the common temperature, left sulphate of lime, which was collected on a filter weighing 6.85 grains, and washed eight times with 100 grains of the solution of sulphate of lime. Having passed completely through the filter, the latter was put, in a wet state, into a platinum crucible. Its weight was found to be 27.2 grains, and after calcination, 0.5 grain of ashes remained. Now, as the filtering paper employed was known to leave 0.32 per cent. of ashes, the quantity of the sulphate of lime separated from the magnesian salt, will be equal to

$$\frac{0.5-(27.2\times0.002+6.85\times0.0012)}{0.998}=0.438 \text{ grains.}$$

This quantity is 0.038 grains more than it ought to be; but

it would most likely have approached still nearer to exactness, if the washing of the precipitate had been repeated oftener. At any rate this method of analysis deserves by far the preference, where smaller quantities of lime are to be separated from larger ones of magnesia. It scarcely need be mentioned that the solution of sulphate of lime must be of such a concentration, as not to yield a spontaneous precipitate by standing, and that the filter must be covered to prevent evaporation.

The calcined residue of a similar solution, if dissolved in 300 grains of water (instead of the solution of sulphate of lime), did not leave any weighable traces of sulphate of lime.

On the Influence of Gum Arabic on the Precipitation of Lead by Sulphates.

Sulphate of soda produces, after a few minutes, a precipitate in a solution of crystallized acetate of lead, when the latter is $\frac{1}{3000}$ of the liquid. But when the water at the same time contained $\frac{1}{50}$ of its weight of gum arabic, a precipitate was only obtained with $\frac{1}{1000}$ of the acetate. With $\frac{1}{1500}$ of the acetate there was no precipitation, even after a few hours, and the same was the case when the liquid contained $\frac{1}{20}$ of gum arabic, and the acetate amounted to $\frac{1}{1000}$. The cause of this anomaly cannot be ascribed to the suspension of the precipitate by the viscid fluid; for neither standing for a few days, nor boiling, assists the efficacy of the precipitant, whilst a few drops of acetic, nitric, or sulphuric acid, instantly occasions precipitation.

On the Reduction of Arsenic by a Single Galvanic Circuit.

Professor Buchner found this method of detecting small quantities of arsenic, objectionable, on account of the arsenic being volatilized in a great measure in the shape of arseniuretted hydrogen. Repeating these experiments in a small apparatus, such as Professor Dobereiner recommended for similar purposes*, I conducted the arseniuretted hydrogen

* A glass tube, open at both ends, is closed at its lower end by a bladder tied over it, the upper aperture being hermetically sealed with a good cork, furnished with a syphon-like tube, of very small bore, to conduct the gas, through which a copper or platinum wire is passed. The tube being filled with the acid solution, is put, together with a piece of zinc foil, attached to the upper end of the wire, into a larger vessel containing a solution of muriate of ammonia or soda.

into a test tube, containing a few drops of a solution of the perchloride of mercury. The arseniuretted hydrogen produces first a yellow precipitate, which, after passing through various shades of brown, at last becomes black, and decomposes the perchloride gradually into calomel*. This test is so nice, that $\frac{1}{500}$, even $\frac{1}{1000}$, of a grain of metallic arsenic dissolved (either in the form of arsenious acid or of arseniate of potash, though the latter requires a longer period for its decomposition) in 100 parts of a diluted muriatic acid, was still indicated, although the greater part of the arsenic was precipitated as a black powder. This effect is not prevented if the arsenical liquid contains, at the same time, much organic matter in solution, even though the latter surpass by 2000 times the weight of the arsenic present. Nitric and nitromuriatic acid prevent the disengaging of arseniuretted hydrogen, almost entirely, even if $\frac{1}{50}$ of a grain of arsenic be present. When a copper wire is made use of, arsenic with metallic lustre is precipitated on that part of the wire which is above the surface of the liquid; and if the surface of the wire is augmented by being bent into spiral windings, the gas thus disengaged, precipitates the mercurial salt less copiously. The arsenic is not carried up mechanically, for a disc of thin pasteboard sealed to the wire, at some little distance from the surface of the liquid, did not impede the effects. The arsenic adhering to that part of the wire which dips into the liquid, appears in the form of a black powder. With platinum wire I could not observe this phenomenon. In a similar galvanic circuit, the interior of the tube being filled with diluted muriatic acid, the exterior one with a solution of muriate of ammonia or soda, the copper wire becomes tarnished, and that part of it which is in the liquid, is covered after some time with a film of a black substance. This change, however, cannot be at all confounded with the appearance which the wire assumes from the presence of arsenic; nor is the solution of the perchloride of mercury changed in the least, as was to be anticipated by the hydrogen gas.

* The phenomena attending this decomposition will vary in some measure if an excess of the arseniuretted hydrogen should happen to be present. Berzelius has examined them, and he states the perchloride of mercury to be such a delicate test for the arseniuretted hydrogen as to indicate even $\frac{1}{10,000}$ of it in a gaseous mixture.

I have a few words to add, touching the nature of the galvanic circle above described. It appears to me, that its effects are as much depending upon the electromotive power of the liquids, as on that of the metals: for if both cylinders are filled with a solution of chloride of sodium or muriate of ammonia, no hydrogen gas is evolved at the negative metal*; and the briskness with which the gas is disengaged, increases with the greater difference in the electro-chemical nature of the liquids employed. Thus, the interior of the cylinder being filled with diluted muriatic acid, hydrogen gas will be more rapidly disengaged, if the interior one be filled with a solution of caustic alkali, in preference to a neutral salt. If, on the contrary, the electro-negative metal be in contact with the electro-positive liquid, scarcely any evolution of gas is visible—and the less, the more the liquids differ in their electro-chemical relation.

On the Limits of the mutual Reaction of Iodide of Potassium and Chloride of Platinum.

Iodide of Potassium, with an additional quantity of diluted sulphuric acid, renders a solution of the perchloride of platinum, containing $\frac{1}{10,000}$ of the chloride, at the first moment, brown-red, the liquid becomes afterwards dark green, and a black precipitate is ultimately produced. If the solution of the chloride of platinum is still more diluted, it turns red by the reagent, and it is still very distinctly so when the chloride is $\frac{1}{1,000,000}$ of the weight of the liquid. The limit where iodide of potash is still indicated by perchloride of platinum, and some additional sulphuric acid, is at $\frac{1}{100,000}$ of the iodide. Starch, with an addition of fuming nitric acid, indicates the iodide very distinctly, if it amounts to $\frac{1}{100,000}$ of the solution, its colouring being limited at $\frac{1}{500,000}$ of the salt present. The reaction was not impeded when the solution contained at the same time a quantity of chloride of potassium, equal to 10,000 times that of the iodide.

* If both metals are at the same time in contact with a diluted acid, hydrogen gas is evolved at the negative wire; but in this case, the instantaneous formation of a metallic salt on the surface of the metal must be taken into account. In a paper published in Poggendorff's Annalen der Physik, 1825, I have treated more at large on the electromotive power of the binary combinations and their solutions.

Nitrate of silver and chloride of gold are very readily reduced by the protoxide of iron, just precipitated from its solution. Thus, a diluted solution of nitrate of silver in ammonia indicates the crystallized protosulphate of iron, if only amounting to $\frac{1}{100,000}$ of the liquid.

German Spa, Brighton, June 1st, 1828.

Letter from Dr. Nicholas Mill.

SIR, *Bogota, Colombia, November* 23, 1827.

I TAKE the liberty to forward you, for insertion in the 'Quarterly Journal,' an account of the earthquake which has just desolated this city, and also of a new mineral substance consisting of sulphuric acid and alumine. This mineral salt is unknown, I believe, except as an artificial production; I shall, therefore, take leave to call it *Davite*, in honour of Sir Humphry Davy. I also send you an analysis of a salt spring in the Andes, containing iodine in the shape of hydriodide of potassium. I have also discovered a new vegetable alkali in the Quina Blanca of Mutis, (Cinchona Ovalifolia, Cinchona Macrocarpa of Vahl,) which I call Blanquinine, to distinguish it from others, and to convey an idea from whence it proceeds. I am now engaged in examining its salts, the results of which I shall forward you upon another occasion.

Earthquake in Colombia, November 16, 1827.

On the 16th of November, 1827, at a quarter past six o'clock in the evening, the inhabitants of Bogota in Colombia were thrown into the greatest consternation and alarm by the severest shock of an earthquake which has ever been known to visit that city.

At the moment of its occurrence, a subterraneous noise was very distinctly heard, resembling the noise of a carriage passing briskly over the pavement, and a white thin transparent cloud was seen to hang over the city; this cloud has been noticed in Italy, as generally, if not always, present near the volcanic commotions of that country, previously, and at the time of these commotions. This cloud is entirely unlike any other which I have ever noticed, and resembles a thin gauze veil.

I noticed it not only upon this occasion, but also in the earthquake of June 17th, 1826, in this city*.

The earthquake took a direction from S. E. to N. W., in which it could plainly be traced by the havoc which it made. Its effects on the city were partial in the above direction, but every part was convulsed.

The confusion and affliction which such a calamity occasions, particularly in a catholic country, can neither be imagined nor described. I was sitting reading in a small house of one story above the ground-floor, when the trembling commenced; the table on which my book lay, first shook, and almost at the same instant, the chair on which I sat; I immediately got on my legs, but found much difficulty in sustaining myself without holding by some fixture; the house all this time rocking to and fro as in a hurricane, but not a breath of air stirred. After passing ten or more seconds in this way, I collected my reason sufficiently to run down the steps into the street; all this time the earth was in motion. When I arrived at the portal of the door, I found it impossible to stand without holding very tight by the doorway, and many persons fell on their faces. During these moments, part of the house adjoining mine fell with a terrible crash, and the street was filled with a cloud of dust, out of which emerged a man distorted with horror, but who had almost miraculously escaped immolation, without any other hurt than what his fright had occasioned. After continuing a *minute or more*, the trembling ceased, and nothing could now be heard but the cries of the people; with that exception all was still and silent, and the stars appeared with all their brilliancy, as if smiling at this scene of human distress. Some persons asserted, that there were two distinct shocks, but I must confess I felt the earth in motion during the whole period of a minute or more; and being situated over the direction which the earthquake took, was, therefore, better able to judge of this, than others who were more distant, and particularly as I retained my presence of mind. Fortunately

* If I may be allowed to offer a conjecture on the cause of this singular white veil, or cloud, I can only attribute it to the vapour of water which escapes from the earth from the heated mass below, and which is condensed on rising into the cold air, and thus rendered visible. Bogota, according to my measurement, which corresponds very nearly with that of Baron Humboldt, is 9600 feet above the level of the sea, and is distant at least one hundred miles from any known volcano.

for me my house was well built, for had it fallen, I should inevitably have been buried in the ruins. To describe the scene which ensued is difficult; the streets were filled with despair; some entirely and others half naked were seen on their knees imploring divine protection with all the energy which the catholic religion empowered them, each hailing his favourite saint to stretch forth his hand and help them, with the enthusiasm of madmen; no one knew what to do or where to fly, for all were in the same consternation and distress. After this had a little subsided, the city became soon deserted, and a fresh scene presented itself; all those who had horses, were seen scampering through the streets towards the plain, to elude the terror of another shock, others on foot with their beds on their backs; and the sick, wrapped up in blankets, were conveyed in armchairs, with two sticks passed underneath them to form sedan chairs, and some were conveyed in hammocks. This afflicting sight, accompanied by the cries of the distressed and the melancholy chaunt of their progress, was painful in the extreme; and hard, indeed, must be that heart, who could view it with indifference; yet such was the apathy occasioned by terror, that scarcely any one offered assistance to his neighbour, and frequently neglected his own safety. When all was quiet, I went out to examine the city. The first thing which attracted my notice was the turret of the stately cathedral partly demolished, and the building split and cracked in various places; the precious stones, consisting of diamonds, emeralds, and topazes, which adorned the interior, were scattered in all directions, and many of them broken, particularly a very large emerald weighing some ounces. This edifice had but just been repaired from the effects of the earthquake in the preceding year, and was, by this last, reduced to a tattered ruin. In all the streets which ran in the direction of N. W. and S. E., many houses were "levelled with the dust," and others "rent in twain," and some of the unfortunate inhabitants buried beneath their ruins. In all, fourteen persons have lost their lives; and the damage done to the city is estimated to be at least six millions of dollars, although it did not contain a larger population than 30,000 souls. Deserted streets, heaps of ruins, and tottering houses, threatening to

crush the beholder, give but a faint idea of this desolate picture. General Soublette and General Bolivar were both present at the last fatal earthquake in Caraccas, and they both assert that this, of which I have now given a description, was at least as powerful, although the suffering in the town of Caraccas was much greater; and they attribute the happy escape of thousands of lives to the difference in the construction of the houses in the two places. General Bolivar, as well as myself and others were affected with sickness at the stomach, after the shock. During the night of the earthquake in Bogota on the 16th of November, 1827, tremulous motions of the earth were continually felt, and the following day, and every other since; and even whilst I am now writing, slight undulating motions are perceptible.

Every person is still in the greatest alarm, dreading a second severe shock, which happened last year at the distance of four days from the first grand shock; should this happen now, scarcely one stone will remain upon another in Bogota.

Native Sulphate of Alumine, or DAVITE.

This mineral salt occurs near a Thermal spring which contains free sulphuric acid, at Chiwachi, an Indian village in the Andes, one day's journey from Bogota, in Colombia. It exists in mass of a white, green, or yellow colour; these differences of colour indicate some changes in the difference of composition. The yellow variety contains sulphate of iron, the green, sulphate of copper also; but the white is solely sulphate of alumine. The copper and iron may be considered as extraneous substances. When a portion of the mass is separated, the fracture, if examined by a lens, exhibits a multitude of fine silky crystals, resembling the crystals of sulphate of quinine; its taste is nauseous and highly astringent.

Before the blow-pipe on charcoal, it first gives out its water, next sulphurous and sulphuric acids, and ultimately becomes a white powder. Under the blue flame this powder appears snow-white; fused with borax and nitrate of cobalt, it gives a fine blue glass. The salt is very soluble in water, leaving a little impurity undissolved; the solution changes the vegetable

blues to red, permanently. Muriate of barytes occasions a copious precipitate in this solution. Ammonia gives a gelatinous white precipitate, which, when collected on a filter, gradually assumes a pinky hue. Prussiate of potash occasions a blue precipitate. Muriate of platina occasions no change, and the absence of potash or ammonia is thus ascertained.

Analysis.

1. Fifty grains of the whitest of the salt were dissolved in distilled water, and the whole dissolved except 1.6 grain, which consisted of sand and clay, extraneous substances, and not therefore chemically combined with the mineral salt.

2. This solution was treated with ammonia, and a gelatinous precipitate obtained.

3. This precipitate was collected on a filter and boiled with a saturated solution of pure soda, when a portion remained undissolved—this was collected, dried, and weighed 0.6 grain, and was oxide of iron, the state in which it existed in the salt being probably that of protoxide.

4. The soda solution, No. 3, was then *saturated* with nitric acid, and a gelatinous precipitate of alumine deposited, which, when collected and exposed to a strong heat, weighed 7.5 grains.

5. The liquid remaining from process 2, was then treated with muriate of barytes, to obtain the quantity of sulphuric acid in the salt; the precipitate obtained was sulphate of barytes, which, after exposure to a strong red heat, weighed 42.4 grains, equivalent to 14.4 grains of sulphuric acid.

6. If the salt contained no other ingredients, this liquid could only contain muriate of ammonia, it was, therefore, evaporated to dryness, and exposed to a strong heat, when the whole was evaporated; the salt, therefore, did not contain potash, soda, or a metal, except the iron before obtained, which was evidently accidental.

This new mineral, therefore, consists of

	Grains.
Extraneous substances, not soluble in water	1.6
Oxide of iron	0.6
Alumina	7.5
Sulphuric acid	14.4
Water	25.9
	50.0

Or, as they exist in the mineral salt, in 100 parts:

	Grains.
Extraneous substances	3.2
Sulphate of alumine	38.0
Sulphate of iron	2.4
Free sulphuric acid	4.6
Water	51.8
	100.0

Description and Analysis of a Mineral Water existing in the Andes, with a Test for Iodine.

Since the discovery of iodine and the researches of Sir H. Davy and Gay Lussac, this substance has been found in several mineral waters and marine plants, and the waters which have contained it have often been distant from the sea, but not out of the sphere of supposed communication. During my residence in this country, I have discovered iodine in many of the saline springs in the Andes, at very different altitudes, and which did not give the usual indications of an hydriodic salt with the test of sulphuric acid and starch. M. Balard*, in examining the waters and products of the Mediterranean, and Dr. Cantee also, when operating upon those of Castelnuevo d'Asti†, discovered the same circumstance; it became necessary, therefore, to search for other re-agents more applicable. The nitrate or acetate of silver I found a very delicate test for iodine in most of its combinations and to answer the necessary indications ‡. The salt spring now under consideration is situated in the hacienda, or farm of Señor Rafael Arboleda, fifteen leagues from the city of Popayan, in the Andes, at a height of ten thousand feet above the level of the sea, and at a distance, in a straight line, of at least eighty or ninety miles from that element §. The situation of this spring approaches

* Annales de Chimie, tome xxviii. p. 179. † Ibid. tome xxviii. p. 221.

‡ Dissolve one grain of hydriodide of potassium and three grains of common salt in 3000 grains of water, and add a solution of nitrate of silver, the liquid will immediately become milky; it must then be heated, when the chloride and iodide of silver formed, will separate from the water. Collect this precipitate and digest it in ammonia, when the chloride of silver will be dissolved, and the iodide of silver will remain. The delicacy of this test is so great, that in a small portion only of this mixture it was perceptible, whilst the ten ounces of the mineral water, when evaporated to dryness, gave but a very slight pink tinge with starch.

§ It is very near and at the same altitude where the bark called *Pitayo*, so celebrated for its febrifuge properties, is found.

the regions of eternal snow, and affords the extraordinary phenomenon of the presence of a substance always obtained from saline bodies, that either are, or have been in communication with the sea, at a height above and a distance from it, which precludes the probability of such communication, but at the time of an universal deluge. These springs are constant in their course, and in their progress they percolate a rough stony soil, and are spread over a surface of nearly seven leagues, that is to say, in an extent of seven leagues there are multitudes of these springs. These springs are denominated in the idiom of the Indians indigenous to the district of Paes, in the province of Popayan, in the Cordilleras, *Asnenga*, which means a mixture of salt and aracachas *, *as* being the name for aracacha, and *nenga* for salt. This mixture forms their common food. The temperature of the air at this spring averages 55° Fahrenheit all the year round.

Analysis of the Water.

Its properties.—Cold, limpid, no smell, specific gravity at 60° Fahrenheit, 1018, taste salt, and slightly astringent. It restores the colour of litmus reddened by an acid, turns turmeric paper brown, and effervesces with acids. Acetate of silver occasions a copious white precipitate in the water, all of which, except a very small portion, is soluble in ammonia. Acetate of barytes occasions a white precipitate, which effervesces with acids, and is partly dissolved. Oxalic acid occasions a white precipitate; muriate of platina no change; sulphuric acid and starch, no change.

1. Ten ounces, by measure, of this mineral water were evaporated down to half the bulk, when some carbonate of lime separated, which was collected and dried at a temperature of 150° Fahrenheit, and weighed two grains.

2. The remaining liquid was evaporated down to dryness, and the residue digested in alcohol of specific gravity 82, at 60° Fahr. The spirit was then evaporated, and the dry mass weighed 1.8 grain, which was again dissolved in water, and treated with a saturated solution of acetate of silver; the white precipitate thus procured was then digested in ammonia, in

* The carrot of the country.

which liquid the whole was dissolved, with the exception of $\frac{1}{10}$ grain, which was iodide of silver, and is equivalent to $\frac{7}{100}$ grain of hydriodide of potassa, in which state it existed in the mineral water, as was indicated by muriate of platina. This 1.8 grain of alcoholic residue, therefore, consisted of chloride of silver 1.7 grain, equivalent to 0.7 grain of chloride of sodium, and $\frac{1}{10}$ grain of iodide of silver, equivalent to $\frac{7}{100}$ grain of hydriodide of potassa.

3. The residue, not soluble in alcohol, was digested in as small a portion of water as possible, to dissolve all the soluble part of it; the insoluble residue was dried, and weighed 2.7 grains; it was then treated with muriatic acid, and the whole was dissolved with effervescence except $\frac{3}{10}$ grain of oxide of silicium; the residue, insoluble in water, therefore consisted of carbonate of lime dissolved by muriatic acid 2.4 grains, and oxide of silicium $\frac{3}{10}$ grain.

4. The solution which contained the remaining salts was now treated with acetate of barytes, to ascertain the quantity of sulphuric and carbonic acids in combination; the precipitate was collected, dried, and weighed 20 grains; it was then treated with muriatic acid, which dissolved the carbonate of barytes formed with effervescence; the remaining precipitate undissolved was sulphate of barytes, which, when submitted to a red heat, weighed 4.2 grains; these were deducted from the former weight, and 15.8 grains remained due to the carbonate of barytes. We have, therefore, 4.28 grains of sulphate of barytes, equivalent to 1.43 sulphuric acid, or — 2.52 sulphate of soda; 15.8 grains carbonate of ditto, equivalent to 3.47 carbonic acid, or — 8.4 carbonate of soda.

5. The remaining solution now contained only the muriates and acetate of soda, which were decomposed by acetate of silver; the precipitate was then collected, dried, and weighed 136.1 grains, which were chloride of silver, and equivalent to 34.4 grains of muriatic acid, and 57 grains of chloride of sodium, or common salt.

The remaining solution was evaporated, and crystals of acetate of soda obtained.

7. A portion of this crystallized salt was then dissolved, and tested with muriate of platina, for potash, but no precipitate appeared; these crystals, therefore, contained no potash.

10 ounces of this water, or 4375 grains, therefore, contain

Carbonate of lime	4.4
Hydriodide of potassa	0.07
Oxide of silicium	0.3
Carbonate of soda	8.4
Sulphate of soda	2.52
Chloride of sodium	57.00
Water	4302.30
	4375.00

The striking facts relating to this mineral water are its existence at such a great altitude, and the presence of hydriodide of potassa in it. We know that muriatic acid does not decompose the hydriodides; we are not, therefore, surprised to find hydriodide of potassa in waters in which the muriate of soda exists; but the sulphuric acid does decompose them; its affinity for soda is less than for potassa, with which the hydriodic acid is here combined, and yet it would appear that no change is effected by double decomposition. With abundance of carbonate of soda, and the sulphate of the oxide of sodium in solution with hydriodide of potassa, we should expect, in the order of affinities, to find the hydriodic acid united with the soda, and the sulphuric acid to retain the potassa; this, therefore, seems an exception to a general rule. Thenard states, in his System of Chemistry, that iodine has never been found to exist in nature but in the state of iodide of potassium. It is surprising that this water does not contain a single atom more of potassa than is held in combination by the hydriodic acid, and it seems to countenance the opinion that iodine does not naturally exist but in combination with potassa.

Earthy Bitumen, called Murindó.

This substance is found at Murindó, near Navitá, in the Province of Chocó, in Colombia. It takes its name from the village of Murindó.

It is externally of a blackish brown colour; when broken, the fracture is earthy and uneven, and the colour of the fractured part is much lighter. It yields to the nail, and is sectile; it is dull, and leaves a mark on paper: when in powder, it has a pungent smell; the taste is hot and peculiar. Before the blowpipe, it first ignites, and burns with a thick smoke, leaving a shining black coal. The smoke, whilst burning, has the pleasant odour of benzoin.

Examination of this Substance.

Specific gravity less than water.

2000 grains of distilled water at 60° Fahrenheit dissolve three grains of this substance; alcohol of specific gravity 82, at 60° Fahrenheit, dissolves a considerable quantity of it, and forms a red tincture.

Water decomposes this tincture and precipitates resin. It has not any tannin.

Benzoic acid may be obtained from it by sublimation. This substance consists of altered resin, benzoic acid, and earth, and appears to be produced by the decay and carbonization of some tree containing benzoin, of which there are many in Colombia. It is used by the natives medicinally as a styptic or astringent. In this particular the Indians follow the Persians, in the country of which people a similar substance exists, and is so highly prized for its medical virtues, as to become royal property. Murindó resembles, in many respects, this bituminous earth from Persia.

On the Mechanism of the Act of Vomiting. By Marshall Hall, M.D., F.R.S.E., &c. &c.

Two opinions have divided physiologists respecting the nature of the act of vomiting. It was originally and long thought that this act consisted simply in a sudden and forcible contraction of the stomach itself. Afterwards Bayle, and Chirac, and more recently M. Majendie, considered that the stomach is inactive, and evacuated by being subjected to pressure by the simultaneous contraction of the diaphragm and abdominal muscles.

It appears to me that neither of these opinions is correct. M. Majendie distinctly proves by actual observation, and by the substitution of a bladder in the place of the stomach, that the contraction of this organ is not usually subservient or necessary to the act of vomiting. I refer to the interesting paper* of that eminent physiologist for the more full elucidation of this first question. I proceed to state such observations as appear to me to controvert the second, and to establish that view of this subject which I have myself been led to adopt.

* Mémoire sur le Vomissement, par M. Majendie. A Paris, 1813.

It is obvious that, if vomiting were effected by a contraction of the diaphragm, it must be attended by inspiration. If this were the case, the fluids ejected from the stomach would be drawn into the larynx, and induce great irritation, events which are not observed. These events are, indeed, effectually prevented by an accurate closure of the larynx, a fact observed in an actual experiment by M. Majendie, who makes the following observation:—"Dans le vomissement, au moment où les matières vomies traversent la pharynx, la glotte se ferme très-exactement *." It is astonishing that this observation did not lead its acute author to see that, under such circumstances, a contraction of the diaphragm, unless the thorax followed precisely *pari passu*, was impossible.

Complete vomiting has been observed, too, in cases in which the stomach had entirely passed through a wound of the diaphragm into the thorax, and in which it could not, consequently, be subjected to the action of that muscle †. In some experiments, vomiting was observed also to take place, although the diaphragm had been paralysed by a division of the phrenic nerves, or its influence subtracted by a division of its anterior attachments ‡.

This view of the subject is still further confirmed by facts, which I now proceed to state, which prove that the act of vomiting is an effort, not of inspiration, but of expiration. This is obvious enough, indeed, on a mere observation of the state of the thorax and abdomen during vomiting. The larynx is evidently abruptly and forcibly closed, the thorax drawn downwards, and the abdomen inwards.

Such, indeed, appears to me to be the precise nature of the act of vomiting, in ordinary circumstances. The contents of the thorax and abdomen are subjected to the sudden and almost spasmodic contraction of all the muscles of expiration, the larynx being closed so that no air can escape from the chest, and the two cavities being made one by the floating or inert condition of the diaphragm. The mere mechanism of the act of vomiting differs little, therefore, from that of cough-

* Mémoire sur l'Usage de l'Epiglotte dans la Déglutition, p. 3, note.

† Such a case is mentioned by Wepfer. A similar one was also recently witnessed by Dr. Webster and Mr. Hunt. The whole of the stomach was found in the thorax, having passed through a wound of the diaphragm. There was repeated vomiting of a substance resembling coffee-grounds.

‡ Œuvres de Car. Legallois. A Paris, 1824, tom. ii. p. 104.

ing, by which, indeed, the contents of the stomach are frequently expelled; the larynx, in the former, is, however, permanently,—in the latter, only momentarily closed; and there is, doubtless, a different condition of the cardiac orifice and of the œsophagus.

It appeared to me, from these views of this subject, that, if an opening were made into the trachea, or through the parietes of the thorax, the effort of expiration constituting the act of vomiting, would issue in expelling the air through these orifices respectively, and the evacuation of the stomach would be prevented; and I determined to submit the fact to the test of experiment. I took a little dog, made an ample opening into the windpipe, and gave a few grains of the sub-sulphate of mercury. The animal soon became sick. The first efforts to vomit induced a forcible expulsion of air through the orifice in the trachea. These efforts soon became very violent, however, and the stomach at length yielded a part of its contents. It was perfectly evident that the violent contractions of the abdominal muscles pressed upon the viscera of the abdomen so as to carry the diaphragm upwards to its fullest extent, and that at this moment vomiting was effected. The act of expiration was so forcible, that a lighted candle placed near the tracheal orifice was several times extinguished. In a second experiment, a free opening was made into the thorax between the sixth and seventh ribs of the right side. The lung collapsed partially only. During the first efforts to vomit, air was forcibly expelled through this orifice, the lung was brought almost into contact with it, the stomach was not evacuated. But as the efforts to vomit became extreme, a portion of lung was driven through the thoracic opening with violence and a sort of explosion, and at the same instant the stomach yielded its contents. These experiments appear to admit only of one explanation, of one conclusion,—that the act of vomiting is a forcible expiratory effort, the larynx being firmly closed, and the diaphragm perfectly inert.

It must be regarded as singular that M. Bourdon, by whom the action of the expiratory muscles, in their various "efforts," has been so well investigated*, should have adopted other views of the act of vomiting.

* Recherches sur le Méchanisme de la Respiration, &c. Par Isid. Bourdon. A Paris, 1820.

It is not intended to state that the act of vomiting is simply such as I have described. There are many facts which appear to show that the œsophagus is not without its share of influence in this act, and it is plain that the cardiac orifice must be freely opened; for mere pressure upon the viscera of the abdomen will not, in ordinary circumstances, evacuate the contents of the stomach. To effect this open state of the cardiac orifice, it is probably necessary that the diaphragm should, indeed, be in a relaxed rather than in a contracted state.

A singular and interesting fact was noticed by M. Majendie, of which he has not given any explanation. During the state of nausea which preceded the act of vomiting, in some of his experiments, air was drawn into the stomach. I am disposed to think that this effect was produced in the following manner: the larynx being closed preparatorily to the act of vomiting, an attempt at inspiration is made before the effort of expiration. In this attempt, air is drawn into the œsophagus, the larynx being impervious, and it is afterwards probably propelled along that canal into the stomach itself. It is not improbable, too, that, in some instances of vomiting, in which the action of the abdominal muscles was subtracted *, a similar effort of inspiration has drawn substances from the stomach into the œsophagus, which has eventually expelled them by an inverted action. Neither of these phenomena could result from any action of the diaphragm, and much less from contraction of the abdominal muscles. But it is easy, by closing the larynx and attempting to inspire, to draw air into the œsophagus. A similar act, if very forcible, might draw a portion of the contents of the stomach through the cardiac orifice.

Such, then, appears to be the nature of the act of vomiting. How different is this act from one in which the diaphragm does, indeed, contract suddenly, under similar circumstances of closure of the larynx,—viz. singultus: the action of the diaphragm being an effort of inspiration, air is apt to be drawn into the œsophagus with considerable noise; and there is occasionally pain, not only about the insertions of the diaphragm, but about the closed larynx.

* Œuvres de Legallois, tom ii. p. 105.

To the Editor of the *Quarterly Journal of Science.*

SIR,

The inclosed scheme for illustrating the distributions and connexions of the several grades of physical existence has been floating in my mind for years. It would be tedious to point out the successive stages, from forming the chain of Bonnet into a circle, and believing each link to be composed of smaller links, and these of smaller still, and so on, without any definite number; to the present scale, in which three will be found nearly to pervade the whole. Yet I cannot forbear stating that as this number was not originally assumed, but only so far admitted as natural affinities seemed to justify the choice, so it is not now proposed as essential to the system, which attempts to indicate the provinces of nature, and to illustrate their indissoluble connexions, whatever be their number, and whatever their extent. Should the trine distribution, as I suspect, be found hereafter universally to prevail, for directing my attention to it on *principle* I shall ever feel indebted to my friend, Mr. George Field, whose very philosophic [illegible]togenea, &c.,' go far to evidence the truth of that which others had only arbitrarily adopted.

Should you think the plan sufficiently matured for publication,—and from having seen several of the diagrams, you are aware that it has been considerably extended to particulars,—a more fit vehicle cannot be found than the Journal of Science.

I have the honour to remain,

Yours respectfully,

G. T. B.

Illustrations of Nature; or, the Arrangement of Physical Existence, indicated in Outline.

Nature, a convenient term to avoid a periphrase, is used to signify the *world*, the *universe*, i. e., all physical existences, all natural powers, beings, things; *e. g.*, attraction is a power in nature; a man, a being; a stone, a thing; thus each and all are parts of nature; for nature is a whole which doth of such parts consist.

There are three kingdoms established in nature; the animal, the vegetable, and the mineral; and all natural existences are presumed to be arranged, or arrangeable therein. "The division of all natural objects into three great classes, is," says Dr. Thompson, "so simple, and, apparently, so consistent with nature, that it must have originated at a very early period of society."—"Philosophers, therefore, almost by common consent, have classed all natural productions according as they appear to belong to the animal, the vegetable, and the mineral or fossil kingdoms." But much, perhaps enough, has been both done and written to prove, what even daily experience would suffice to show, that this ordinary arrangement of physical existence is fundamentally erroneous; and, although sanctioned by very high authorities, and almost sanctified by immemorial usage, still the three kingdoms of nature are arbitrary and incorrect *divisions.* Not that we mean to say that the animal kingdom should be undistinguished from the vegetable, and the vegetable from the mineral; but that the difference between the inorganic mineral, and the organic vegetable, is greater than between the organic vegetable and the likewise organic animal kingdom; therefore, although correct in distinguishing the three, it is incorrect in the unnatural division; arbitrary, in confusing the rational or human with the sensual or merely animal creature; and defective, by excluding from any place in the system of nature whatsoever, those inanimate yet immaterial powers, and those superior grades of being, the which, although not immediately evident to our senses, and only known by their effects, undoubtedly do exist; and if so, they ought to be arranged in a scale of nature, or physical existence. Incorporeal spiritual beings are neither minerals, nor vegetables, nor animals, and yet they do exist: again, attraction, light, heat, electricity, exist in nature, and are essential parts thereof; are these either animals, or vegetables, or minerals? As physical existences they should somewhere be arranged: and hence the proposition by several philosophers, to institute an igneous, and other kingdoms.

But the ordinary distribution of the earlier naturalists hath so generally obtained, and the application, at first sight, is so ap-

parently simple and easy, that although philosophers have long since shown the division to be defective, arbitrary, and incorrect, the terms animal, vegetable, and mineral kingdoms still continue in common use, and superficial observers rest satisfied with their propriety; yet to those who look deeply into the subject, such insuperable difficulties do occur, that modern naturalists reject the primary division of the vegetable from the animal kingdom, and admit only two great classes, the organic and the inorganic; the one subject to the laws of chemistry, the other to the laws of life. This distribution, as far as it goes, is indeed just, natural, and perfectly easy; it only wants the extreme to inanimate, inorganic matter, to be added, to render the arrangement philosophically complete; and thus we should enumerate, instead of the mineral, the vegetable, and the animal kingdoms, the lifeless, the living, and the spiritual; or rather, the inorganic, the organic, and the metorganic realms. (vide col. 1 and 2 of table, p. 400.)

Thus physical existences may, probably, with more accordance to nature in theory, and more convenience to art in practice, be arranged in these three realms or first kingdoms; for the extremes of conceivable existence are either purely intellectual or material, in which mind and matter exist alone and unconnected; the medial state is that mean in which they are reciprocally in intimate communion; in which neither mind nor matter is predominant, and from which central point they are on either side in unequal relative proportion; this medial state is the organic realm, the extremes, the metorganic and inorganic; the one relating to immortal, the other to lifeless beings; while the mean is both living and mortal.

To illustrate nature generally, or even the three reigns of either realm, would involve too great prolixity; therefore, leaving in this stage of the inquiry both the metorganic and inorganic, we will confine our observations solely to the organic.

From a perspective view of the organized creation, it is immediately apparent that, as vitality is the essential characteristic of the whole, the subdivisions can only be relatively distinct; the extremes (and, therefore, the intermediate parts) can only differ from each other and from their mean in degree;

consequently no absolute demarcation can exist; for, as the material ascends through the organic to the spiritual, so does the vital through the sensual to the rational creation. The lowest organic grade is that which only lives; the medial, that which lives, and feels; the superior, that which lives, and feels, and reasons; *i. e.*, the vital, the sensual, and the rational natures*; or the vegetable, the animal, and the human reigns. The rational is sensual and vital; the sensual is also vital, but the vital has nothing which it doth not possess in common, or which is not included in the constitution of the other two.

As organic beings, in two of their grades, have systematically been divided from each other as widely as from the inorganic world, *e. g.*, the animal, the vegetable, and the mineral kingdoms; and two of their grades, *viz.*, the rational or human, and the sensual or mere animal, have been as generally confused together, it becomes imperative that we more than cursorily insist upon the dogma, that man endowed with reason rises as much above, and is by that, his characteristic quality, as fairly distinguished from the dog, the horse, the elephant, or the monkey, as the lower tribes of animals, the polypes, &c., are from the tremellæ, and azotic plants; and many animals show less obvious signs of sense and instinct than do the mimosa, dionæa, hedysarum, &c., which are avowedly subjects of the vegetable reign. It may seem that we are here pandering to the pride of man, by placing him in a class and reign different from that of animals. Let it not, however, be supposed that man is not an animal; yet he is no more an animal than an animal is a vegetable; a vegetable is an organic being, endowed with the faculty of vegetation, *i. e.*, of vital assimilation, but destitute of sense; an animal is an organic being possessed of the powers of vital assimilation, and in so far a vegetable, but an animal is a vegetable endued with sense; a man is a vegetable in so far as growth and other vegetative phenomena prevail, an animal as regards his instincts, and a MAN as respects his *reason*.

Having faintly traced an outline of the circumstances by which the several grades of organic life become associated, and by which they are distinguished from the material and intellectual reigns on either side immediately contingent, and

having hinted at those subordinate characters in which (although they generally accord) they differ particularly among themselves, we proceed to illustrate their connexions. To assist in explaining the alliances of the realms and reigns of nature, and to reduce the scheme to a tabular form, the system of nature, or the universe, may be represented by a sphere or circle, which, on its analysis, will give so many constituent spheres or circles, as there can be found kinds or grades of physical existence; these lesser circles, being symbols of the first kingdoms or realms of nature; and, if our analysis be correct, they are three, the metorganic, the organic, and the inorganic; [*vide* col. 1 and 2, and diagram 1] the circles partially containing each other, will, on their analysis, furnish other subordinate circles, which will be types of the several grades of existence contained therein; [*vide* col. 3 and 4, and diag. 2] and the analysis, on like principles, may be conducted until particulars which are elements in nature be arrived at.

Each, and all of the realms of nature, may thus be equally developed; but, as in the first stage we passed the metorganic and inorganic realms, so, in like manner, in the second we must leave the rational and vegetable reigns, merely observing, that organic beings are of three grades, and that the rational being, or man, is placed in that part of the circle of organization which is contained in the metorganic or spiritual realm, thus indicating that he hath the quality or characteristic of that circle, superadded to his animal organization; that vegetables, the least removed from inorganic matter, are placed in that part of the circle of organization which intersects the inorganic; for in them is matter most predominant, they being the chief eliminants thereof to the higher grades; and that mere animals hold the intermediate rank; with these hints we leave the extremes, and pursue the centre of the system, drawing examples from the most familiar and best known objects, *viz.*, animals alone.

Systematic naturalists have widely differed in the methodical distribution of the animal kingdom, from the enaima and anaima of the Stagirite, to the more modern classification of the Swede: but whether the presence and absence of blood, the possession and non-possession of vertebræ, the progressive

stages of intelligence, &c. have been the indices, still certain familiar groups have generally remained inviolate; and probably they are familiar purely because they are natural.

These familiar classes would appear to be nine in number, perhaps reducible to three more general groups, which may form the regions of the animal reign.—(*vide* col. 4 and 5.) 1. BEASTS (*Bestiæ, mammalia*). 2. BIRDS (*Aves*). 3. REPTILES (*Reptilia*). These three classes may form the first region, pulmonata, intra-spirantia, or lung-breathing animals. 4. FISH (*Pisces*). 5. FISH ALLIES (*Mollusca*). 6. SHELL-FISH (*Crustacea*). These three classes would seem to associate so as to form the second region, branchiata, medio-spirantia or gill-breathing animals. 7. INSECTS (*Insecta*). 8. WORMS (*Vermes*). 9. PLANT ALLIES, ZOOPHYTES, (*Phytoides, Zoophyta*). These three classes will form the third region, spiraculata, extra-spirantia or skin-breathing animals.

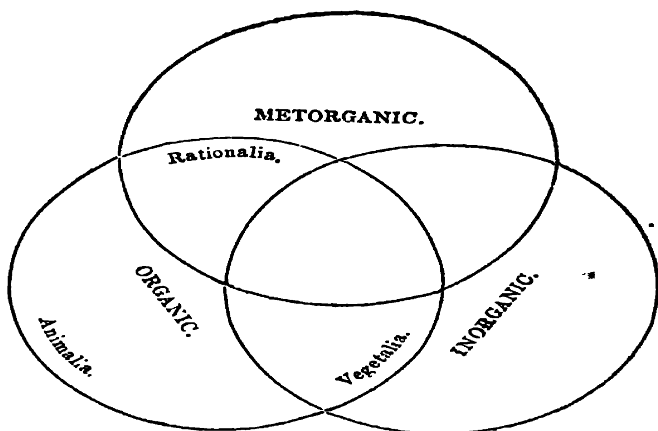
But although these classes are decidedly natural, and the regions, perhaps, not otherwise, still they have many points of connexion, and these not in any regular series of ascent or descent, but blending with, and, as it were, partially containing each other. To insist at length on these curious inter-alliances time will not allow; diagrams 2 and 3, will indicate a few. The pulmonata, or lung-breathers, are placed in that part of the circle of animals which intersects the human, thus indicating, that in structure and high development of sense, &c., some of them approach much nearer to man than do any of the branchiata, or spiraculata, as shown by their situation without the rational circle. The spiraculata, on the other hand, enter the vegetable reign; thus establishing the connexion between some of the polypes and the tremellæ, *i. e.*, of the zoophytes with the azotic plants. The branchiata hold a middle rank. In the development of these regions, three classes present themselves in each—*vide* diagram 3 of the pulmonata. Reptiles being cold-blooded are consequently placed in that part of the circle which is contained in the cold-blooded regions; and some of them, as frogs, breathing at one time by gills, are thus naturally placed near the branchiata to which they are allied. Of beasts, the bat tribes may approach the birds, and the pinnipedatæ, (seals, whales, &c.) the fish. The birds,

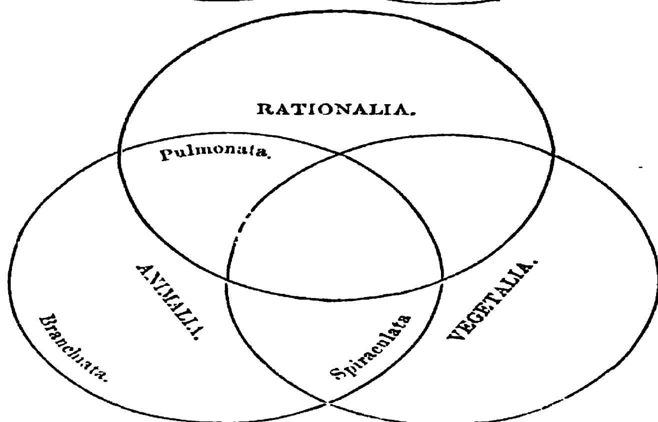
perhaps, by the struthiones, approach the beasts, as they, by the monotremata, again approach the birds, especially the penguineæ; the penguins, scarcely able to walk, are allied to the reptiles, as some of the chelonia to birds. Of the branchiata or gill-breathers, the fish, which are vertebrated animals, more or less developed, from soft membrane or cartilage with horny integuments to more advanced, though far from perfect bone, show their connexion with the other vertebrata by their location in that part of the circle, where the aquatic pulmonata approach them; they are, in fact, in immediate contiguity with the icthyoid reptiles of Blainville; and the ophiognathus of Harwood is a good instance of this connexion; still they are sufficiently distinguished both by their respiratory and circulating systems. The crustacea, which were part of the Linnæan insects, but from which, by having branchiæ, they are distinct, show their alliance by being placed in that part of the circle where the insects of the spiraculata intersect them. Many other secondary alliances might be pointed out, such as the approach of the chelonian reptiles, in which the skeleton is becoming external to the crustacea, and these to the coleopterous insects; the connexion of the marsupialia, which belong to the different tribes, in the same manner as the icthyoid reptiles with the fish, &c., the development of the system will furnish them, at every stage; the accomplished zoologist will readily pursue the plan; but I am forbidden to dilate: perhaps, even now, the limits of an outline have been exceeded; and methinks I hear some considerate friend suggest "cui bono?" a cold unsympathising note of interrogation, which hath often paralysed the efforts of the most ardent theorist. As a theorist, permit me to explain; for as it is an imputation I may have incurred, I will own that it is a character of which I should be proud, were the signification restrained to the original, the proper meaning. For Θεωρεω signifies to behold, to contemplate; Θεωρια should be translated, a contemplation; and Θεωρετικὸς, contemplative. Hence, a theory is a contemplation, or enlarged and liberal view; to theorise is to contemplate, *i. e.*, to behold many subordinate particulars with reference to their mutual interdependence as parts of some greater whole; and, therefore, Θεωρος, a theorist, is a philosopher, in

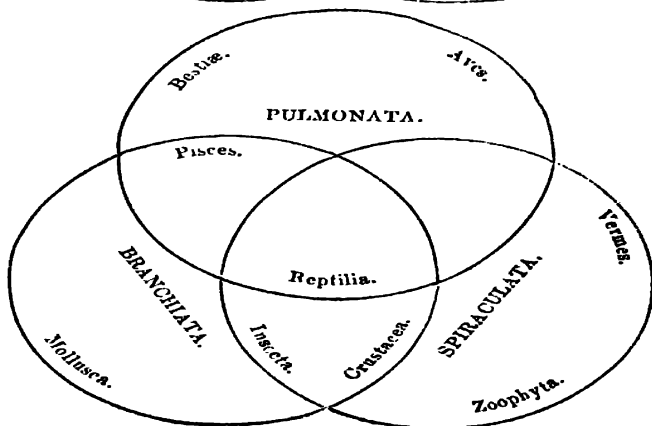
the strictest sense. Theory is to science what design is to a building. Particular instances are the only legitimate materials of philosophy, but particulars are infinite, and facts unarranged are but incumbrances to the mind, as blocks unused are fit only for the mason's yard; the plan is that which determines whether these particulars shall for ever remain in chaos, or whether a rude hovel, a stupendous tower, or an expanded arch shall be therefrom constructed. They who regard theory in any other light than as a convenient mean of associating facts, and arranging the numerous particulars of knowledge, entertain very erroneous notions of its nature and utility. I hold theory in estimation no farther than as it enables me to associate particular truths; and that theory I esteem to be best which enables me, with the greatest perspicuity, to arrange the greatest number of particulars, just as I should esteem that point of vision the best from which I could see most clearly; or that museum the most convenient, in which I could deposit the largest number of specimens arranged to the greatest advantage, and exhibited with the least disorder. Theory is not to be despised; for, as Dr. Young hath elegantly observed, "The phenomena of nature resemble the scattered leaves of the sibylline prophecies of old; a word only, or a single letter, is written on each leaf, which, when separately considered, conveys no instruction to the mind; but, when by the labour of patient investigation every fragment is placed in its appropriate connexion, the whole begins at once to speak a perspicuous, an harmonious tongue." Shall the antiquary with patient zeal explore the defaced and broken characters, rendered almost illegible by the ravages of years, and think his labour well repaid when he can decypher inscriptions graved by men in olden time; and shall the naturalist shrink from the task of contemplating the varied forms of nature, and reading thence an oracle which will reveal truths the most curious, important, and sublime! Some few of these scattered leaves of nature I have attempted to arrange; for as scattered leaves alone they would serve to amuse rather than to instruct, and yet, when collated and disposed in their natural locations, they form a history the most sublime, they compose a volume the most important that human being can contemplate, that finite understanding can comprehend.

1.	2. Realms.	3. Reigns.	4. Regions.	5. Classes.

- **Ens. NATURE. Being.** Existent. Known.
  - **METORGANIC.** Spiritual.
    - **RATIONALIA.** Men.
  - **ORGANIC.** Mortal, Vital.
    - **ANIMALIA.** Animals.
      - Lung breathing. **PULMONATA.** Intra-spirantia.
        - **BESTIÆ.** Beasts.
        - **AVES.** Birds.
        - **REPTILIA.** Reptiles.
      - Gill breathing. **BRANCHIATA.** Medio-spirantia.
        - **PISCES.** Fish.
        - **MOLLUSCA.** Fish allies.
        - **CRUSTACEA.** Shell-fish.
      - Skin breathing. **SPIRACULATA.** Extra-spirantia.
        - **INSECTA.** Insects.
        - **VERMES.** Worms.
        - **ZOOPHYTA.** Zoophytes. Plant allies.
  - **INORGANIC.** Lifeless.
    - **VEGETALIA.** Plants.


METORGANIC.
Rationalia.
ORGANIC.
Animalia.
Vegetalia.
INORGANIC.


RATIONALIA.
Pulmonata.
ANIMALIA.
Branchiata.
Spiraculata
VEGETALIA.

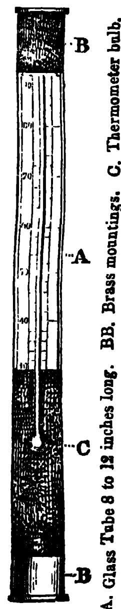

Bestiæ.
Aves.
PULMONATA.
Pisces.
Vermes.
BRANCHIATA.
Reptilia.
SPIRACULATA.
Mollusca.
Insecta.
Crustacea.
Zoophyta.

Account of a New Hygrometer, by George Cumming, M.D.

The distinguished merits of Mr. Dalton must be well known to every one conversant with the progress of Chemistry and Meteorology; and, in common with others, I have ever considered the following experiment for determining the varying force of *aqueous vapour* in the atmosphere, as a genuine specimen of cautious, or inductive philosophy. "In order to find the force of the aqueous atmosphere," (says Mr. Dalton in his "Essay upon the Force of Steam or Vapour from Water and other Liquids of different Temperatures," 5th vol. page 581, of the "Memoirs of the Literary and Philosophical Society of Manchester,") "I usually take a tall cylindrical glass jar, dry on the outside, and fill it with cold spring water, fresh from the well; if dew be immediately formed on the outside, I pour the water out, let it stand awhile to increase in heat, dry the outside of the glass well with a linen cloth, and then pour the water in again; this operation is to be continued till dew ceases to be formed, and then the temperature of the water must be observed; and opposite to it will be found the force of vapour in the atmosphere. This must be done in the open air, or at a window; because the air within is generally more humid than that without. Spring water is generally about 50°, and will mostly answer the purpose the three hottest months in the year; in other seasons an artificial cold mixture is required. The accuracy of the result obtained this way I think scarcely needs to be insisted upon. Glass, and all other hard, smooth substances I have tried, when cooled to a degree below what the surrounding aqueous vapour can support, cause it to be condensed on their surfaces into water. The degree of cold is usually from 1 to 10 below the mean heat of the twenty-four hours; in summer I have often observed the point as high as 58° or 59°, corresponding to half an inch of mercury in force, and once or twice have seen it at 62°; in changeable and windy weather it is liable to considerable fluctuation." But the great objection to this mode of experimenting, it may be observed, consists in the length of time required to verify an observation, to say nothing of the trouble of employing "an artificial cold mixture" for the greatest part of the year. Hence the satis-

faction with which the labours of Mr. Daniell, as well as those of Mr. Jones, to produce a hygrometer that should readily mark the "comparative degrees of moisture and dryness in the atmosphere, and, by exhibiting them in degrees of the thermometer, refer them to a known standard of comparison, and speak in a language which every body understands," have been received by meteorologists.

Of the merits of the hygrometers of Messrs. Daniell and Jones, it would ill become the author to speak, as an accident upon the road, after waiting with impatience for months for the arrival of Mr. Jones's instrument, deprived him of the power of instituting a set of comparative experiments; but should Mr. Daniell's observations upon Mr. Jones's hygrometer, as published in No. XLII. of the "Journal of Science and the Arts," prove correct, the accident above alluded to may fairly be considered the efficient cause of the production of the following improved instrument.



A. Glass Tube 8 to 12 inches long. BB. Brass mountings. C. Thermometer bulb.

The hygrometer in question is extremely simple, and is intimately founded on the principle pursued by Mr. Dalton in his mode of interrogating Nature. But instead of using "a tall cylindrical glass jar, with water fresh from the well, and artificial cold mixtures," I employ the accelerated evaporation of æther, or of a less costly article, rectified spirit of wine, by directing a current of air through a thin glass or metallic tube, of convenient size, containing a delicate thermometer enveloped in sponge or other porous substance: when it will be obvious that, by the affusion of a little æther upon the porous body surrounding the bulb of the thermometer, almost any degree of artificial cold may be produced by simply mounting the prepared tube upon the nozzle of a small pair of bellows, or other pneumatic contrivance; thus rendering, by the abstraction of heat from the tube employed, the condensation of aqueous vapour upon its exterior surface, a matter of ease, certainty, and expedition, while the comparison of the temperature of the air, at the commencement of the experiment, with the mean of the indications

of the thermometer at the appearance and at the evanescence of the dew, opposite to the bulb of the thermometer, will give, with relative accuracy, the measure of the force of vapour in the atmosphere.

But, in general terms, it is not desirable to depress the instrument many degrees below that at which the dew becomes visible, on account of the increased length of time requisite to complete an observation. When the hygrometer is consulted with a view of predicting the greater or less probability of rain, or other atmospheric changes, two things (Mr. Daniell observes) are to be principally attended to—" the difference between the constituent temperature of the vapour, and the temperature of the air, and the variation of the dew-point. In general, the chance of rain or other precipitation of moisture from the atmosphere, may be regarded as in inverse proportion to the difference between the" thermometrical indications: " but in making this estimate, regard must be had to the time of day at which the observation is made. In settled weather, the dryness of the air increases with the diurnal heat, and diminishes with its decline ; for the constituent temperature of the vapour remains nearly stationary. But to render the observation most completely prospective, regard must be had at the same time to the movement of the dew-poinf. As the elasticity of the vapour increases or declines, so does the probability of the formation and continuation of rain. An increasing difference, therefore, between the temperature of the air, and the temperature of the point of condensation, accompanied by a fall of the latter, is a sure prognostication of fine weather; while diminished heat, and a rising dew-point, infallibly portend a rainy season."

The following extracts from Mr. Daniell's Table, showing the force, weight, and expansion of aqueous vapour, at different temperatures, will tend to place the importance of the study of hygrometry to the physician, horticulturist, and man of science, in a favourable point of view.

Temperature.	Force.	Weight of a Cubic Foot.	Expansion.
30	0.200	2.361	.9959
35	0.240	2.805	1.0062
40	0.280	3.239	1.0166
45	0.340	3.893	1.0270

Temperature.	Force.	Weight of a Cubic Foot.	Expansion.
50	0.400	4.535	1.0375
55	0.476	5.342	1.0479
60	0.560	6.222	1.0583
65	0.657	7.230	1.0687
70	0.770	8.392	1.0791

Assuming, therefore, that changes in the aqueous atmosphere* must exercise an important influence upon the general economy of nature, who is prepared to say that, as a healthy man consumes 130 cubic feet of air daily, the manageable relations of heat and moisture, as indicated by the hygrometer, might not be beneficially applied to the treatment of disease, as well in private life as in public institutions; or that, were an increased share of attention paid to the study of atmospheric phenomena, the causes, or "constitution of the air," regulating the rise, type, and progress of disease in general, (a subject deeply involved in obscurity,) might not happily be developed?

Report of the Commissioners appointed by His Majesty to inquire into the State of the Supply of Water in the Metropolis.

To His Majesty George the Fourth, by the Grace of God of the United Kingdom of Great Britain and Ireland, King, Defender of the Faith, &c. &c. &c.

In obedience to the commands contained in His Majesty's commission, directing us to inquire into the state of the supply of water in the Metropolis, and to report our observations and opinions touching and concerning the same, we proceeded, without delay, as soon as the arrangements necessary for executing them

* On the 17th July, 1827, the dew-point, at ten o'clock A.M. was 56°, the temperature of the atmosphere 72°; so that the dryness of the air, under the above conditions, may be conveniently expressed as – 16°; at noon it was 14°; at six o'clock P.M. it had advanced to 10°, and was followed by considerable rain in the night. On the 19th, the dew-point, at noon, was 61°, air 65°, difference 4°, immediately followed by rain. To day (26th) the dew-point is 58°, attended with much rain, the temperature of the air being 62°. But the author has strongly to recommend Mr. Daniell's Essays to the attention of the meteorological student; and, to adopt his language, (in speaking of his invention,) I have only to hope that the new hygrometer "may be judged upon its own merits alone; and if it shall be found to be liable to no errors of construction, and no deterioration from use or age; if its indications shall prove to be infallible, and strictly comparable, under all circumstances; and if, moreover, it be easy to observe, and its observations applicable without the trouble and uncertainty of *formulaic* calculations, I shall hope that, for the good of science, it may be generally adopted."

could be completed, to investigate the important subject referred to us. The circumstances which prevented our meeting for the purpose of that inquiry until December last are stated in our correspondence with the Secretary of State for the Home Department, which is contained in the Appendix to this report. From the terms of our commission, and from the tenor of the petitions of the inhabitants of the western portion of the Metropolis, and of the Borough of Southwark, to both Houses of Parliament, referred to our consideration, praying for an inquiry into the quality of the water furnished by the Water Companies, and into the means of procuring an effectual and permanent supply of pure and wholesome water, as well as from the communications with his Majesty's Principal Secretary of State for the Home Department, it appeared that our attention was required to be directed to three principal points; namely, first, to ascertain the *sources and means* by which the Metropolis is supplied with water, and their efficiency as to the *quantity* supplied; secondly, to determine the *quality* of the water; and, thirdly, to obtain such information as might enable us, if necessary, to suggest *new methods* or *sources of supply*, or to point out the means of ameliorating those now in existence. But having since learned, by a recent communication from his Majesty's Principal Secretary of State for the Home Department, that our inquiry is to be limited to the description, the quality, and the salubrity of the water, and that we are not called upon either to consider new and more eligible sources of supply, or to suggest plans for the improvement of those already existing, we have agreed upon the following report, respecting the two former subjects.

In investigating the supply of water in respect to *quantity*, we proceeded, in the first instance, to collect the requisite information as to the powers and resources of the different water-companies upon the north side of the Thames; first procuring evidence from the companies themselves as to the extent and facilities of their supplies, and afterwards checking such evidence by collateral testimony from other witnesses, and occasionally by personal examination into the facts.

The supply of this, the most extensive portion of the Metropolis, is dependent upon five companies, which, arranged in the order of the number of tenants they serve, and nearly in that of the quantity of water which they respectively furnish, stand as follows:—

The New River,
The East London,
The West Middlesex,
The Chelsea, and
The Grand Junction Companies.

Of these companies, the New River derives its principal supplies of water from a spring at Chadwell, between Hertford and Ware, and about twenty-one miles north of London; and also

from an arm of the river Lea, the source of which is near the Chadwell spring, in the proportion of about two thirds from the former, and one third from the latter. These united waters are conducted by an artificial channel nearly forty miles in length, to four reservoirs, called the New River Head, at Clerkenwell; proper means being adopted to prevent the ingress of fish and weeds, and such arrangements being made in respect to the mains as to prevent interruption of service in case of repairs. Since, however, the abandonment of the London bridge, and of the York Buildings water-works, whose former districts are now supplied by the New River Company, they have found it advisable to erect an engine at Broken Wharf, Thames-street, by which they are enabled occasionally to supply parts of their district with Thames water, when, from long-continued droughts, severe frosts, or other accidental causes, the flow of the New River is impeded. It appears, however, that the quantity of Thames water thus supplied bears a very trifling proportion to the other source, the engine at Broken Wharf having been worked for seventy-six hours only, in January and February of last year, and for one hundred hours during the drought of July and August. The number of tenants supplied by the New River Company is between 66,000 and 67,000, and the quantity of water which is daily supplied exceeds 13,000,000 gallons, being about 2,000,000 cubic feet.

The East London water-works are situated at Old Ford, on the river Lea; but as the tide of the Thames flows up that river to the extent of a mile beyond the works, and as their supplies are taken during the ascending tide, the description of water thus furnished will closely approximate to that of the Thames. This company has four reservoirs; the number of tenants supplied amounts to about 42,000, and the daily consumption of water to nearly 6,000,000 gallons, or about 950,000 cubic feet.

The West Middlesex water-works are upon the banks of the Thames, at the upper end of Hammersmith, and draw water exclusively from that river, opposite to the works. They have two reservoirs, one at Kensington and one at Little Primrose Hill, which are supplied by the engines at Hammersmith, and they serve about 15,000 tenants. The average daily consumption of water is 2,250,000 gallons, or about 360,000 cubic feet.

The Chelsea water-works are upon the banks of the river, about a quarter of a mile east of Chelsea Hospital; and their supplies are derived entirely from the Thames, opposite to their works. They have two reservoirs, one in Hyde Park, and one in the Green Park, close to Piccadilly. They supply about 12,400 houses; the average daily supply to the whole being about 1,760,000 gallons, or nearly 282,000 cubic feet.

The works of the Grand Junction Company are also at Chelsea, immediately adjacent to, and east of the Hospital. They derive the whole of their supply of water from the river Thames, with which they fill three reservoirs situated at Paddington; and from

these their district is served. The number of their tenants does not appear to exceed 7700; but their daily consumption of water is about 2,800,000 gallons, or upwards of 450,000 cubic feet.

It appears from this statement that the portion of the town upon the north side of the river Thames, including the cities of London and Westminster, is supplied daily with a quantity of water amounting to nearly 26,000,000 gallons, and that the total number of houses and buildings receiving this supply amounts to about 144,000. The water is, of course, very unequally distributed, the average consumption in each house being apparently greatest in the district supplied by the Grand Junction company, where it amounts to about 363 gallons daily per house. Taking the average of the whole supply, the daily consumption of each house is about 180 gallons. Of this water, more than one half of which is derived from the Thames, a large portion is delivered at very considerable elevations above the level of the river, constituting what is called *high service*; for which purpose fifteen steam-engines are employed, exerting a power of about 1105 horses.

It is obvious, from the above statement, that the *quantity* of water supplied in London and Westminster is abundant; and in our examinations of individuals touching the quality of the water, we have in no instance met with complaints of deficiency in quantity. We have reason to believe that the hospitals, workhouses, and other similar establishments, where an abundance of water is an essential requisite, are in all cases duly supplied; and upon the important subject of supply in case of fire, our evidence leads us to believe that of late it has always been ample, and that when not immediately procured, the fault has lain with the turncocks; for among other advantages of the reservoirs annexed to the Works upon the Middlesex side of the river, is that of having at command a large head of water, by which the mains are kept full, and in many districts are under considerable pressure. The supply of a large quantity of water upon any sudden emergency is thus ensured; and among other great advantages arising out of the substitution of iron for wooden mains, is that of their sustaining the pressure of a column of water which it would have been impossible, in the former state of the works, to have commanded.

As far, therefore, as regards the description and quantity of water supplied to the Cities of London and Westminster, it appears that more than half the consumption is derived from the Thames, and that it is in such abundance as not only to supply all necessary demands upon ordinary and extraordinary occasions, but that a proportion is constantly suffered to run to waste, by which the cleansing of the drains of houses and of the common sewers is effectually accomplished, all accumulations of filth obviated, and the general healthiness of the metropolis promoted.

We next proceeded to examine into the supply of water to those parts of the metropolis situated upon the south side of the river,

including the Borough of Southwark. We found that they are dependent upon three establishments, known as

The Lambeth
The South London, and
The Southwark water-works.

The first of these is upon the banks of the Thames, between Westminster and Waterloo Bridges, drawing its supplies from the river immediately opposite to the works. They have no reservoir, the water being forced immediately from the river into the mains, and thence distributed to about 16,000 tenants, who consume 1,244,000 gallons daily, or nearly 200,000 cubic feet.

The Vauxhall, or South London water-works are situated in Kennington Lane, and have also an engine on the river at the foot of Vauxhall Bridge. They supply Thames water exclusively, and have reservoirs for the service of their upper engine. The number of their tenants is about 10,000, and the daily consumption of water about 1,000,000 of gallons, or about 160,000 cubic feet.

The Southwark water-works are upon the bank of the river, betw en Southwark and London Bridges, and derive the whole of their water from the middle of the river opposite to their engines. It appears that about 7000 tenants are supplied, by this establishment, with about 720,000 gallons of water, or 115,000 cubic feet daily.

Each of these establishments has two engines,—the aggregate power of the six may be estimated at about 235 horses. The whole of the water which they supply amounts to nearly 3,000,000 gallons, or 485,000 cubic feet daily, which is distributed among 33,000 tenants.

There appear to be no just complaints respecting the quantity of water furnished by any of these companies, except in cases of fire, when there has occasionally been a serious deficiency. We have inquired into the causes of this, and are induced to refer it to the want of proper reservoirs for preserving a head of water upon the mains when the engines are not working. On these occasions much time is often lost in sending to the engine of the district, and if the steam be not up, and the fire low, further and fatal delay sometimes occurs.

In reference to the total amount of the quantity of water required for the daily supply of the inhabitants of the metropolis, and for the use of the various manufactories requiring it, it appears to be about 29,000,000 gallons, or 4,650,000 cubic feet.

We next directed our attention to such facts respecting the *quality* and *salubrity* of the water with which the inhabitants of London are supplied, as were in our judgment best calculated to enable us to form a correct and unprejudiced opinion upon this important question. Being a question, however, in which the interests of a great number of individuals and public bodies are deeply involved, and which has been the subject of acrimonious controversy,

and also respecting which a variety of representations had gone forth to the public, we perceived that it would necessarily embrace a multitude of considerations of a delicate and complicated nature. We felt it to be our duty, therefore, to begin by dismissing from our minds whatever previous impressions might have been received from the reports and statements which had been circulated, and to be guided in our judgment solely by the evidence we should be enabled to obtain in the execution of our commission.

In our remarks upon this evidence, we shall first confine ourselves to the water of the River Thames.

Assuming the supplies to be derived directly from the river, and to be subjected to no intermediate process tending to purification, it is sufficiently obvious that the state of the weather will materially affect the purity of the water, which is sometimes comparatively clean and clear, and at others loaded with various matters in mechanical suspension, rendering it more or less coloured and turbid. In the latter state, when thrown into cisterns, and other receptacles of houses, it is manifestly unfit for immediate use; but after being allowed to rest, it forms a certain quantity of deposite, and thus may become sufficiently clear for ordinary purposes. This deposite, however, is the source of several evils; it renders the cisterns foul, and runs off into those pipes which issue from or near the bottom of the reservoirs. By the agitation which accompanies every fresh influx of water, this deposite is constantly stirred up, and becomes a renewed source of contamination to the whole mass; and although chiefly consisting of earthy substances in a state of minute division, it is apt also to contain such proportion of organic matters as will occasion a degree of putrefaction when collected in any quantity, and especially in warm weather. Of this deposite, more or less is almost always collected, especially where the service is direct from the river; and although some of the companies have reservoirs of such magnitude as to enable them to serve water already partially purified by deposition, the system is still very imperfect, and the water is frequently supplied in a turbid state. In other cases, the companies' reservoirs, however eminently useful in cases of fire, become objectionable in regard to the purity of the water, since the mud accumulates in them, and also proportionately in the mains and branch pipes.

By far the greater number of complaints which have been made to us with respect to the quality of the water have originated in the cause just alluded to; and hence some of the companies have attempted to get over the difficulty by suffering the water to remain at rest for a sufficient time to become clear before the public are supplied, and in this they have, in some instances, so far succeeded as materially to improve their service. When, however, from land floods or other causes, the river is very thick, they cannot allow due time for such subsidence; and even when most perfectly performed, the insects contained in the water, so far from being got rid of, become, perhaps, even more numerous.

This is another just cause of complaint in regard to the water, especially in hot seasons.

To obtain an effectual supply of clear water, free from insects and all suspended matters, we have taken into consideration various plans for filtering the river water through beds of sand and other materials; and considering this, on many accounts, as a very important object, we are glad to find that it is perfectly possible to filter the whole supply, and this within such limits in point of expense as that no serious objection can be urged against the plan on that score, and with such rapidity as not to interfere with the regularity of service.

It must, however, be recollected, that insects and suspended impurities only are separated by filtration, and that, whatever substances may be employed in the construction of filtering beds, the purity of the water, as dependent upon matters held in a state of solution, cannot be improved by any practicable modification of the process. If, therefore, it can be shown that water taken from the parts of the river whence the companies draw their supplies, either is, or is likely to be contaminated by substances dissolved, or chemically combined, it will follow that the most perfect system of filtering can effect only a partial purification.

From the commencement of our inquiries we have bestowed considerable attention upon this subject, and have endeavoured to obtain accurate information respecting it. But on examining such analyses of the water as had already been made, and were communicated by the companies, as well as by several individuals of high authority on these matters, we found them to be so far at variance with each other as to prevent our drawing from them satisfactory conclusions. We, therefore, devised a more regular plan of procedure, which we conceived would be better suited to the particular objects of our present inquiry. After all the preparations for that purpose were completed, the occurrence of a heavy fall of snow, the effects of which on the water of the river would have introduced uncertainty in the results, induced us to defer for a time the execution of our plan. We waited till the river had returned to what may be regarded as its average state, and under these circumstances, directed portions of water to be taken, under the personal inspection of our secretary, from different parts of the river at different times of the tide, and especially from those parts whence the companies draw their water; and also from situations higher up the river, where its quality can in no degree be influenced by the tide. With the view of comparing the state of the Thames water at London under different circumstances, we subsequently procured specimens from several parts of the river after an abundant fall of rain; and also others from places where it had been represented to us as particularly charged with impurities. A popular notion having prevailed that the water in the London Dock possessed peculiarly deleterious qualities, from an impregnation of copper derived

from the bottoms of the ships, we likewise obtained, with a view to inquire into the truth of this opinion, portions of water from the dock, taken at three different depths from the surface.

In order to ensure the subjecting of all these various specimens to the most careful and rigid examination, upon one uniform system, we put them, for that purpose, into the hands of Dr. Bostock, a gentleman eminently qualified for the task by his extensive knowledge of chemistry, and his practical experience in this department of analysis. In the Appendix will be found the detailed account of his examinations, in the accuracy of which we have every reason to repose the fullest confidence. In his report to us, he justly remarks that it would have required a much longer space of time than was allowed him, to have performed a complete scientific analysis of so many specimens of water; but the results he obtained are quite sufficient for the object proposed, and to which we more particularly directed his attention, namely, "to ascertain how far the water of the Thames, contiguous to, or in the neighbourhood of London, is in a state proper for being employed in diet and various other domestic purposes."

The general conclusion he deduces from the whole series of examinations is expressed in the following passages of his report:—

"It appears that the water of the Thames, when free from extraneous substances, is in a state of considerable purity, containing only a moderate quantity of saline contents, and those of a kind which cannot be supposed to render it unfit for domestic purposes, or to be injurious to the health. But as it approaches the metropolis it becomes loaded with a quantity of filth, which renders it disgusting to the senses, and improper to be employed in the preparation of food. The greatest part of this additional matter appears to be only mechanically suspended in it, and separates by mere rest. It requires, however, a considerable length of time to allow of the complete separation; while, on account of its peculiar texture, and comminuted state, it is disposed to be again diffused through the water by a slight degree of agitation, while the gradual accumulation of this matter in the reservoirs must obviously increase the unpleasant odour and flavour of the water, and promotes its tendency to the putrid state.

"Regarding the greatest part of the extraneous matter in the Thames as mechanically mixed with it, we may conceive that a variety of incidental circumstances will affect its quality in the same situation and under the same circumstances of the tide; but the observations are sufficiently uniform to warrant us in concluding, that the water is in the purest state at low tide, and the most loaded with extraneous matter at half ebb. It would appear, however, that a very considerable part, if not the whole, of this extraneous matter may be removed by filtration through sand, and still more effectually by a mixture of sand and charcoal."

The examination of the water taken from the London Dock, showed that it did not contain the smallest appreciable quantity of copper.

We have also endeavoured to gain information from various other sources respecting the state and purity of the Thames water, and its general fitness for domestic use; and from such inquiries it appears proved to us, that the quality of the water within certain limits, included in what may be called the London District, has suffered a gradual deterioration within the last ten or twelve years. We found this opinion upon the well-ascertained fact of the disappearance of fish from those parts of the river, to such an extent, as to have led to the almost entire destruction of the fisherman's trade between Putney Bridge and Greenwich; and upon the circumstance that the eels imported from Holland, can now with great difficulty be kept alive in those parts of the Thames where they were formerly preserved in perfect health. We also learn that the fishmongers in London find it impossible to preserve live fish for any length of time in water taken from the same district.

The causes of these effects are, perhaps, principally to be traced to the increase of certain manufactories, amongst which, those of coal gas are the most prominent, polluting the river by their refuse; to the constant passage of steam-boats, by which the mud is stirred up, and to the peculiar nature of that mud within the above-mentioned precincts. The very circumstance also of the great abundance with which water is supplied to the houses and manufactories of the metropolis appears to be essentially connected with the augmented impurity of the river; for where refuse animal and vegetable matter of various descriptions used to be collected, and from time to time removed for the purposes of manure, it is now indiscriminately washed into the sewers, and conveyed into the Thames: and the sewers themselves are rendered much cleaner than formerly by the quantity of water which runs to waste, and which, as already remarked, has rendered them less offensive, especially in those parts of the town where they used to be most liable to stagnation and consequent putrescence. Thus it has been stated to us that the water of the river is more polluted immediately after heavy rains, which force down the contents of the sewers, than after a continuance of dry weather, when its course is sluggish or altogether arrested; and the results of experiments we directed to be made on the subject fully establish this fact. The great increase which has of late years taken place in the population of London, and of its suburbs on every side, must also be attended by a proportionate augmentation in the quantity of extraneous matter carried down into the Thames.

There are other circumstances affecting the fitness of the water, as now taken from the river for the supply of the town, which, though less general in their influence, should not be overlooked; such as the position of the suction pipes of the engines belonging to some of the companies in regard to the mouths of sewers, the quantity of dead animals thrown into the river in and about London, its contamination by the offal of slaughter-houses, and

a variety of other causes, which we need not here specify, but which will be found on reference to the evidence; some of these we have inquired into in detail, and have anxiously sought for means by which the nuisances in question might be remedied or abated; but it is manifest that, if the general quality of the river water be objectionable within the whole of that district whence the supplies for the metropolis are drawn, any remedies for local evils become comparatively unimportant; and although these diminish as we ascend the river, we apprehend that their influence, with that of the other contaminating causes, will be more or less felt nearly to the extent to which the tide reaches.

The statements which have been made respecting the insalubrity of the Thames water, as supplied by the companies, have also been considered by us; and although, from the few cases which have been brought before us of disorders imputed to this cause, we do not feel ourselves warranted to draw any general conclusions, we think the subject is by no means undeserving of further attention. There must always be considerable difficulty in obtaining decisive evidence of an influence, which, although actually operating to a certain extent as a cause of constitutional derangement, may yet not be sufficiently powerful to produce immediate and obvious injury. It cannot be denied that the continued use of a noxious ingredient in diet may create a tendency to disorders, which do not actually break out until fostered by the concurrence of other causes; for we unquestionably find an influence of the same kind exerted by other agents, which occasion merely a certain predisposition to disease, and of which the immediate operation must therefore be extremely insidious and difficult to trace. It is obvious that water receiving so large a proportion of foreign matters as we know find their way into the Thames, and so far impure as to destroy fish, cannot, even when clarified by filtration, be pronounced entirely free from the suspicion of general insalubrity. In reference also to this question, we apprehend that there are no grounds for assuming the probability of any improvement in the state of the water drawn from the London district of the river.

Although the principal supply of water by the New River Company is not open to the same objectionable impregnations as that of the Thames, we think it, nevertheless, susceptible of much improvement. The occasional deficiency in quantity, which suggested the necessity of the engine at Broken Wharf, might be obviated by allowing a portion of that supply to be drawn from the River Lea at Lea Bridge.

But here, as in respect to the Thames, the water is occasionally very muddy, receiving as it does the drainage of a considerable extent of country, in consequence of a right claimed by the proprietors of adjacent lands, and which the company have at present no means of obviating; neither have they any power to prevent persons from bathing in their aqueduct.

These evils they would very gladly remedy if enabled to do so; and their removal, together with the adoption of an extensive system of filtration, would materially contribute to the perfection of the New River supply. Great benefit would result, not only to the extensive district of London supplied by this company, but also to the public at large, if the inducement to bathe in the open canal of the New River were superseded by the establishment of baths in the neighbourhood of the metropolis, to which the public might, under certain regulations, be allowed access. It has been stated to us in evidence, that the New River Company have voluntarily offered to furnish sufficient supplies of water for a purpose of such manifest and general utility.

Taking into consideration the various circumstances to which we have now adverted, together with the details of evidence by which they are proved and illustrated, and also the facts derived from our own observation and experience; we are of opinion, that the present state of the supply of water to the metropolis is susceptible of, and requires, improvement; that many of the complaints respecting the quality of the water are well founded; and that it ought to be derived from other sources than those now resorted to, and guarded by such restrictions as shall at all times ensure its cleanliness and purity.

Various schemes proposed by different individuals, for the attainment of these desirable objects, have occupied our attention in the course of our inquiries; but the complete examination of any plan of this kind, with reference to its practical efficiency and expediency, would necessarily have required the taking of surveys of the ground, and the determination of levels of different points comprehended in such plan. The limits which have been assigned to our inquiry, and the manner in which our Report has been demanded, have precluded such further investigation of this important subject as we had originally contemplated, and for which, indeed, we had been making preparation. But while we must, consequently, refrain from any further remarks upon the remedies applicable to the existing evils, and upon the best means of conveying a sufficient supply of water of unexceptionable quality to the inhabitants of the metropolis, we are unwilling to close our labours, without expressing our strong sense of the importance of this object to the public, and our earnest hope that its full investigation by competent persons will not be long deferred. As, however, the materials we had collected with a view to this more extended inquiry may still be useful to those by whom the inquiry is resumed, we have thought it proper to insert them in the Appendix to this Report. Some part of the evidence offered to us by one of the companies, relating to projected alterations and improvements, and which was not in a sufficiently mature state to be made public, has, at the request of that company, been withdrawn, on their finding that we had not the power of prosecuting the inquiry to the extent originally contemplated.

We have not entered into the question of the effects resulting from the mutual compact agreed upon by the several water companies on the Middlesex side of the Thames, with regard to the limitations of the districts they respectively supply, it having been expressly stated to us by his Majesty's Principal Secretary of State for the Home Department, at the time our commission was issued, that the grievances imputed to this cause were not to form any part of our present inquiry, inasmuch as they had been the special subject of consideration by a Select Committee of the House of Commons, appointed for that purpose in the year 1821, and by whom a report relating to those matters has been made. The opinion given by that Committee was, that in consequence of the peculiar nature of the undertakings of companies for the supply of water, where large capitals must necessarily be vested in fixed machinery, and where, from the commodity furnished being of no value but for consumption on the spot, the sellers are confined to the market by the nature of the trade, the principle of competition in its application to such companies requires to be guarded by particular checks and limits, in order to render it effectual without the risk of destruction to the competing parties, and thereby ultimately of a serious injury to the public. The only remark we shall venture to make upon this subject is one naturally suggested by the evidence which has come before us in the course of our inquiries, namely, that if, on the one hand, the preservation of the present water companies, from which the public have undoubtedly derived immense benefits, would be endangered by unlimited competition with new companies that might be established for similar objects, it must, on the other hand, be evident, when due regard is had to the consideration, that the constant and abundant supply of pure water is an object of vital and paramount importance to the inhabitants of this vast metropolis; that the dispensing of such a necessary of life ought not to be altogether left to the unlimited discretion of companies possessing an exclusive monopoly of that commodity; and that the interests of the public require, that while they continue to enjoy that monopoly, their proceedings should be subjected to some effective superintendence and controul.

P. M. Roget, (L. S.)
William Thomas Brande, (L. S.)
Thomas Telford, (L. S.)

9, *New Palace Yard, Westminster,*
April 21, 1828.

Proceedings of the Royal Institution of Great Britain.

Weekly Evening Meetings.

March 7th.

The subject of the evening consisted of an account and illustration of some Supplementary remarks on the Reciprocation of Sound. The matter belonged to Mr. Wheatstone, but was delivered by Mr. Faraday. The new information contained in it has been embodied in the account given of the subject of Resonance, at page 175 of this volume.

The tables in the library were furnished as usual with objects of interest.

March 14th.

Mr. Turrell gave the members an account of the chemical menstruums used for etching upon steel plates; he also described and exhibited an instrument, called a perspectograph, for laying down points in perspective.

A very large specimen of native silver from Mexico was placed amongst the other objects upon the library table.

March 21st.

Mr. Millington gave an account of the manufacture and uses of paper, accompanied with models and illustrations of the recent improvements.

Specimens of all kinds of paper were placed in the library, and amongst them, some recently manufactured from straw, by a new process.

March 28th.

Dr. Harwood gave an account of the structure and economy of the Greenland whale, illustrated by numerous fine specimens, preparations, and drawings of the animal and its various parts.

A variety of productions from the East were placed upon the library tables, by favour of Lady Raffles and Mr. Bennet. Some of them were presented by the latter to the Museum. Dr. Boott also gave a specimen of the wax myrtle plant (Myrica Cerifera), and of the myrtle wax from the same plant.

A drawing instrument, invented by Mr. Ronalds, was explained in the library. A pencil and a small bead are so connected together by means of a thread passing over pullies, that if a person, looking through an eye piece, will hold the pencil upon a sheet of paper, and then watching the bead will move his hand, so that the bead shall trace the lines of any object that is selected to be looked at, he will find that, whilst he has been doing this, he has also made a drawing of the subject upon the paper; for the pencil and the

bead describe exactly the same lines, though upon different planes. Thus a drawing is made without ever looking at the paper, but solely at the object.

The meetings, having been suspended during Passion and Easter weeks, were again resumed on the evening of Friday,

April 18*th*,

when Mr. Ainger described and illustrated the various escapements for timekeepers.

His object, he said, was to explain, by means of very enlarged models, the principles and action of those ingenious and beautiful contrivances which are generally little understood, because of the minuteness of their parts and the rapidity of their motions, which render their mode of operation in machines of the ordinary size too obscure and transient to be understood by mere inspection. To obviate this difficulty, a model was made three feet in diameter, of the wheel called the escape wheel, which in common clocks is not as many inches in diameter, and in watches is of course much less. This model, with its appendages, was made to move with a proportionate degree of slowness, so that the action and reaction of the parts became obvious and intelligible.

A timekeeper may be divided into two parts:

1. The motive part,
2. The regulating part.

The first merely produces motion, the second regulates its velocity.

The motive part may be subdivided into

(1) The motive power, which is a weight or spring.

(2) The distributive power, which is a train of wheels increasing the velocity, and of course diminishing the intensity of the force arising from the descent of the weight, or the uncoiling of the spring.

The use of the train of wheels will be understood by considering that the weight or spring barrel of a thirty day clock, will not make, perhaps, more than ten revolutions, while the second's hand of the same clock will, in the same time, make fifty thousand revolutions. The train of wheels, therefore, multiplies the insensible velocity generated by the weight or spring, till it becomes the visible velocity of the second's hand, which is placed on the axis of the last wheel of the train called the *escape wheel;* this wheel has, therefore, a constant tendency to move in obedience to the impulse communicated through the train from the weight or spring. This tendency to move is what keeps the clock going; but the motion requires to be regulated, and made perfectly uniform, which leads to a consideration of the other essential part of a timekeeper, the regulating part.

This may also be subdivided into two parts:

(1) The pendulum, or balance, which governs the rate.

(2) The escapement, which transmits that government to the train, and in return transmits the impulse of the train to the pendulum.

In order to understand properly the escapement, we must have some idea of the properties of the pendulum.

A body suspended so as to move without friction, and exposed to no resistance from the air or other causes, being made by means of equal impulses to perform equal vibrations, would perform them in equal times, even if we had no better proof of the fact, than the old metaphysical argument, that there is no sufficient reason to the contrary. So also, though there be friction at the point of suspension, and air resisting the vibration, if that friction, and that resistance of the air, be quite invariable, the vibrations would continue invariable both in quantity and time, for the same want of a sufficient reason otherwise. In all this, however, we have assumed three impossible conditions.

In the first place, it is impossible always to give exactly equal impulses to the pendulum.

In the second, the friction is likely to vary from temperature, and from the changes which the oil, or other lubricating material, undergoes.

In the third, the resistance of the air changes from temperature, moisture, and other circumstances.

These causes (with others) preclude the possibility of making a pendulum perform for any length of time exactly equal vibrations; and since the longer vibrations of a simply suspended pendulum occupy more time than the shorter ones, it becomes an incorrect measure of time. The error produced in this way is very slight, yet enough to be sensible in instruments so perfect as they are now made. The times occupied in describing a complete semi-circle, and the smallest sensible arc, differ only in the proportion of 34 and 29; and the error becomes much less, in proportion as the differences between the arcs of vibration are less.

If, however, as is well known, a pendulum could be made to vibrate, describing the arc called a cycloid, it would perform all its vibrations, whether long or short, in equal times; and it was, therefore, proposed by Huygens, to attach to the upper part of the pendulum an apparatus which should cause it to describe cycloidal arcs, and thus to free it from the errors arising from changes in the arc of vibration. It was found, however, that this apparatus required an impracticable degree of accuracy in the workmanship; and therefore

it was abandoned for the better plan of endeavouring to make the arcs of vibration as small and as equal as possible. This is the problem, which has for two centuries exercised the ingenuity of the first mathematicians and mechanics of the world, and the best solution of which it is our object to illustrate.

The three difficulties presented by this problem are, as before stated:

1. The varying friction of the pendulum.
2. The varying resistance of the air.
3. The varying impulse given to the pendulum.

For the first and second no compensation is attempted to be made; they are merely reduced as much as possible, and this has been done so effectually, that a pendulum once set in motion, has vibrated thirty hours without any renewal of the first impulse.

The third cause of error, the varying impulse given to the pendulum, has been the great object of attack. The disturbance which the pendulum is liable to, from its connection with the motive part of the instrument, is of two kinds. In the first place, the pendulum receives a new impulse at each vibration, in order to maintain its motion; that impulse, it is true, always proceeds from the same weight or spring, but that impulse, will vary when the timekeeper is close wound up, and when nearly down; this, however, is trifling, and can be very nearly compensated by other contrivances: but the weight or spring has to operate through the train of wheels, which, at different times, will have different degrees of friction, and will, therefore, transmit different quantities of power to the escape wheel from which the pendulum receives its impulse.

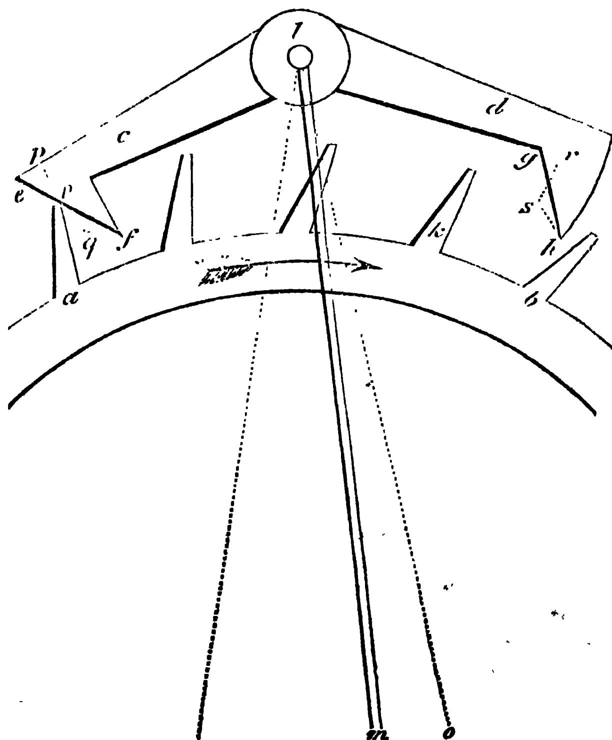
This defect cannot be remedied, that is to say, the motive energy residing in the escape wheel cannot be made uniform. The object sought after has, therefore, been to render the impulse given to the pendulum independent of the force existent in the wheel which gives that impulse; and this has been accomplished by means of successive improvements in the escapement, so perfectly, that increasing the weight attached to a good timekeeper an hundred fold will not increase the impulse given to the pendulum.

In order to understand these gradual improvements in the escapement, we must now observe minutely its mode of operation.

The business of the escapement is to act as a sort of mediator between the escape wheel, (which is always tending to increase its motion by the natural accelerating tendency of the weight or spring,) and the pendulum, which is always tending to diminish its motion from friction, and the air's resistance. The business of the escape-

ment is to modify each of these tendencies; to transmit the accelerating tendency of the escape wheel to the decreasing tendency of the pendulum, and *vice versâ*, thus to neutralize the tendency to change, and to make them move together and equally. After the escape wheel has, by means of one part of the escapement, given the pendulum an impulse, it would run on with increased velocity, but that the pendulum, in return, employs another part of the escapement to stop the escape wheel; and this is the conflict which is always going on; the escape wheel impels the pendulum and then *escapes* (thence its name), but it moves only half the interval between two of its teeth before it is caught by another part of the escapement.

This is the process which takes place in all escapements, though under very different circumstances, and by very different means: it will be rendered intelligible, as regards two of the most common escapements, by the annexed diagram:



in which *ab* is a portion of the escape wheel having a tendency to move in the direction shown by the arrow; *cd* is that sort of escapement called the anchor escapement, the parts *ef* and *gh* are its pallets, *l* is its centre of motion, and *lm* is part of the pendulum rod which is connected and moves with the escapement; the pendulum being in the diagram, nearly at the extremity of its motion to the right, the end *c* of the escapement nearly at its greatest depression, and the end *d*, of consequence, at its greatest elevation; the tooth *b* of the escape wheel is supposed just to have escaped from the angle to the right hand pallet, and the tooth *a* to have just fallen on the left hand pallet between *e* and *f*; as the pendulum returns to the left, the tooth *a* will rub along the surface *ef* till it escapes at *f*, when the tooth *k* will be immediately caught somewhere between *g* and *h*; thus at every vibration of the pendulum a tooth of the wheel would escape, and the wheel be instantly detained on alternate sides of the escapement. The impulse is given to the pendulum by the pressure which the teeth of the escape wheel exert on the surfaces *ef* and *gh* alternately tending to elevate the opposite ends of the escapement, and thus to move the pendulum.

But it must be recollected, that at the instant the tooth *b* escaped from the pallet at *h*, and that the tooth *a* fell on the other pallet at *n*, the pendulum had not finished its vibration to the right, or there would be a danger of the wheel not escaping at all; there must be a considerable quantity of motion left in the pendulum, which will carry it, say to *o*, and during this time the pallet will be rubbing from *n* to *e* against the tooth *a*, and forcing the escape wheel back, in opposition to the direction of the arrow. This effect, which is visible in the second's hands of all common clocks, is called the recoil, and was a property of all the early escapements. It is got rid of by making the pallets of the form shown by the dotted lines, by which it will be seen that each pallet consists of two faces *pq*, *qf*, and *rs*, *sh*, of which *pq* and *rs* are concentric with *l*, the centre of the escapement's motion, consequently, when the teeth of the wheel are rubbing against them, no motion can be transmitted either way, and the impulse to the pendulum is given only while the teeth are pressing against the surfaces *qf* or *sh*. This sort of escapement is called the *dead beat*, from the absence of that *recoil* which gives name to the other.

The objection to the recoil is, that it is caused by the pendulum, and thus interferes with that freedom of motion on which the isochronism of the pendulum depends. It is prejudicial on account of the inequality of resistance which is made to the recoil by the

varying friction of the escape wheel and train, which are forced back. The recoil is, however, by no means the worst objection to an escapement; and all other parts being good, very excellent timekeepers may be made with escapements having a moderate recoil.

It was at one time thought to be a considerable defect, and great pains were taken to remove it by variations in the form of the pallets, on the principle before explained. By these the recoil is perfectly got rid of; but although the pendulum is not employed to force back the escape wheel, the pallet rubs against the tooth during nearly the whole of the vibration; and this, of course, interferes with the free motion of the pendulum.

The next step was to avoid the recoil, and the greater part of the rubbing, which was effected by the *detached* escapement, in which the pallets and the escape wheel are in contact during only a small part of each vibration. Still the pendulum received its impulse directly from the escape wheel, and was liable on this account to irregularities which were obviated by the invention of the *remontoire* escapement, in which the escape wheel winds up a spring, whose return gives an impulse to the pendulum. The impulse is, therefore, always uniform, because the escape wheel can wind up the spring only a certain quantity, whether the maintaining power be great or small.

One of the best escapements, on this principle, is that of Mr. Hardy, published in the 38th volume of the 'Transactions of the Society of Arts.' A large model of this was exhibited and explained; but the parts are too minute to form the subject of an intelligible diagram.

Hitherto no mention has been made of the greatest source of error in timekeepers, that which arises from the effect of temperature on the pendulum, or on that which, in portable timekeepers, is the substitute for the pendulum, and is called the balance. This source of error has given rise to a completely distinct series of inventions, called compensation pendulums and compensation balances, which will probably form the subject of some future illustration.

Several very curious specimens of art were placed in the library, the production of Signor Abbiati. They consisted of inlaid wood of various colours, so arranged, as to give the outlines and colouring of the subjects represented, the effect being a little assisted by lines engraved upon the surface of the wood, and afterwards filled in with black.

April 25th.

Mr. Sieviere gave a practical and illustrated account of the processes used by the Sculptor. He described the operation of modelling in clay, and the use and nature of the tools employed; then proceeded to make a cast in plaster; and afterwards, from other casts, showed how, by means of the statuary's compass, the positions of the various points upon the finished cast were transferred to a block of marble, and the manner in which, guided by these points, the artist wrought the stone, and produced his finished work. The various operations he described were performed by himself, or by workmen; and the use and principles of all the tools employed were explained and shown.

The library tables were covered with a handsome present by Dr. Nicholl, of about 200 volumes of medical literature, which, with the works on the same subject already in the Institution, will probably become the nucleus of a perfect medical library of reference.

May 2d.

Mr. J. Knowles, F.R.S., of the Navy Office, began his account of the rise, progress, and present state of naval architecture. See May 16th.

Numerous specimens of books, minerals, and chemical preparations, were laid upon the tables in the library.

May 9th.

The subject of the evening was the nature of Musical Sound; it was delivered by Mr. Faraday, but supplied by Mr. Wheatstone. Musical sounds differ from noises in their quality of pitch, a quality usually expressed by the terms high and low, grave and acute. So essential is pitch to a musical sound, that it alone renders the sound subject to the laws of melody and harmony. However sounds may differ in other qualities, and those of a bell, a harp, and a flute may be taken as instances, yet agreeing in this, the most unpractised ear can perceive their relation and musical nature.

Gallileo first correctly indicated the nature of the pitch of sounds, and showed that it depended altogether upon the number of vibrations or impulses made by a sounding body in a given time. Thus, if two strings be taken, and one made to vibrate faster than the other, it will yield a sound of a higher pitch; and if it vibrate twice as fast, its note will be an octave higher than that of the other string.

All sounds are produced by impulses or vibrations, which are usually communicated to the auditory nerves, through the medium

of the atmosphere, and these produce an effect according to the number of impulses in a given time. If there be less than thirty impulses in a second, no sound is produced; gradually increasing the number, low sounds are heard at first; but they become higher as the impulses are more numerous in a given time, until, when above 14,000 in a second, the sounds are so acute as to be inaudible to ordinary ears. Whenever the impulses are regular and with any constant velocity, then a sound is produced, having a constant and determinate pitch. A very curious experiment, made by Gallileo, and described in his dialogues, was quoted, which seems to have been forgotten since his time. It consists in drawing the blade of a penknife over a plate of copper sideways, so as to produce sounds; at the same time it is found that a series of indentations are marked on the copper, which indicate the successive impulses which produced the sound; they are extremely regular, and the number of them will be seen, upon examination, to correspond with the pitch of the sound. Mr. Wheatstone has remarked, that in all cases of sound from friction, as when a bow is drawn across the strings of a violin, the same series of impulses are produced, and may be rendered evident, by fixing a small steel bead upon the bow; when looked at by a light or in sunshine, the bead seems to form a series of dots during the passage of the bow.

Hooke performed an experiment, in which a toothed wheel was made to revolve, and a card or quill held against the teeth; sounds were produced having a regular pitch, according to the number of blows or impulses given upon the card in a certain time. The notes produced in this way in the lecture were very distinct, and well characterised as to pitch, more especially the higher ones.

Professor Robison produced the same effect by impulses given to air alone. This was done by blowing air through a stop-cock whilst the plug was rapidly revolving; and as the motion of the plug was more or less rapid, so the tones produced were higher or lower.

An instrument was invented some years ago by M. Cagniard de la Tour, which gave very beautiful results, confirmatory of the above views, and one of them was prepared and experimented with at the lecture table. It consisted of a box, into the bottom of which a pipe was fixed, to blow air through, and in the top of which were formed sixty holes, placed in a circle, and equidistant from each other. A metallic plate was fixed on an axis over the top, so as to be made to revolve at pleasure, and was also perforated by sixty holes coincident with those in the box. When the

plate was made to revolve, the holes in the box were, therefore, opened and closed sixty times in each revolution ; and when air was blown through the box, musical sounds were produced, having a determinate pitch, dependent upon the rapidity of the plate, or rather upon the number of impulses given to the air by opening and shutting the exit passages a given number of times in a second.

A striking point in the character of this instrument is, that whether air or water be passed through it, still the pitch of sound is the same for the same velocity of the plate, being not at all altered by the density or rarity of the substance upon which the impulses are given.

A small musical instrument, recently invented in Germany, was then produced, in which the sounds were caused by successive impulses upon air, like as in the stop-cock of Professor Robison, or the Syren of Cagniard de la Tour, except that, though simpler in practice, the method was more complicated in principle. It was called the Mund Armonica, and consisted of a plate of metal having small rectangular apertures, about half an inch in length, cut in it side by side: there were eight of these holes, and each was furnished with a thin elastic plate of metal, which being fastened at one end of the hole, was so adjusted in size as to vibrate freely in the aperture, which it nearly filled. When the mouth was placed over one or more of these apertures, and air urged forward, it caused the spring to vibrate as it passed it; these vibrations produced so many impulses upon the current of air, and thus caused sound. The plates are adjusted by their thickness, rigidity, and other circumstances, to produce a certain number of vibrations in a given time, and so determine the pitch of sound. The notes produced were very beautiful and clear, having much of the character of those of the Æolian harp.

It was stated that the Eol-harmonica, a keyed instrument, brought from Germany into this country by Mr. Schulz, was constructed upon this principle. Mr. Schulz and his sons, who were present, illustrated the powers and effect of this instrument by various performances.

The principle of the Mund Armonica is distinctly described in Professor Robison's works, p. 538, &c. where he suggests that it will probably be found highly useful in the improvement of musical instruments.

May 16th.

This evening Mr. Knowles concluded his account of the rise, progress, and present state of Naval Architecture in Britain.

He prefaced his First Lecture (delivered on the 2*d* of *May,*) by adverting to the commercial and other advantages which this country has derived from ships; and in order that the terms which he used might not be misunderstood by his hearers, he gave a succinct account of the leading principles of the science of their construction.

To find the displacement of a ship is of the highest importance; hence mathematical and mechanical means have been devised to arrive at the fact, all of which have given way to a method introduced by Chapman, a Swede, which is derived from the parabolic curve, to which the lines of ships' bodies approximate.

Stability is that property in a floating body which it exerts to retain or regain an upright position when under the influence of any force which tends to incline it. The comparative stability of ships may be judged by the distance of their centre of gravity from a point called the metacentre;—this was a discovery of Bouguer. Chapman has also given an easy but elegant method of finding this point, by a formula derived from the parabolic curve.

The little which is correctly known of the resistance of fluids was adverted to, and a remark made, that an important fact has resulted from these inquiries; that, *cæteris paribus*, the resistance which floating bodies meet with in passing through a fluid, is as the respective areas of their broadest section, and that the resistances increase as the squares of the velocity.

The relative proportions of masts and yards to the stability of ships, and to the resistance to be overcome, next came under consideration; and, as the stability of ships increases with regard to their breadth in a geometrical ratio, while, with respect to length, it increases only arithmetically, so the length of the masts are governed by the breadth of the ship, and the spread of yards by their length. The general position of masts in ships of war was stated to be, for the foremast $\frac{1}{9}$ of the length of the ship from the stern, the mainmast $\frac{5}{9}$, and the mizenmast $\frac{4}{7}$; the length to be taken at their line of flotation.

The best proportion of length to breadth of three-masted ships is 3.75 to 4 times their breadth; for length in brigs, 3.27 times their breadth for length; and cutters only 3 times as long as they are broad.

The foundation of the naval power of England was laid by Alfred, who, to prevent invasion, designed himself a fleet of galleys which were, in size, and in every other respect, superior to those

of his opponents. This wise policy enabled him to carry into effect his plans for the internal improvement of the kingdom.

Mr. Knowles carried on the history through the succeeding reigns, and showed that England was prosperous, or otherwise, as the navy was encouraged or neglected.

During the reign of Edward the First, the galleys were substituted by larger ships, called galleons; these, however, were rude in form, fitted with one mast only, and little capable of navigation, unless they sailed in the direction that the wind blew: these ships were fitted with regular castles for the reception of archers or cross-bow men.

Naval architecture and naval science, shortly after this period, underwent a complete alteration; for in 1302 the compass was discovered by Gioija; and in 1346 cannon were introduced into the field, and shortly after into ships: these circumstances combined, brought about a great increase of size in our ships of war, as it required them to be larger than had formerly been used, to carry the guns; and the compass enabled men to put fearlessly to sea into deep water, and not confine themselves to coasting.

Henry the Seventh was the first king, since Alfred, who constructed ships expressly for naval warfare; he laid down a memorable ship, the Great Harry, which, however, was not completed till the succeeding reign. This ship measured 138 feet in length, and 36 feet in breadth, and carried 80 guns of different calibre. The Great Harry had four lower masts and a bowsprit, a round bow, and projecting prow; she had castles forwards, amidship, and abaft, making four on each side.

Henry the Eighth paid great attention to the navy, and established the dock-yards at Woolwich, Deptford, and Portsmouth, and appointed a navy board for their management.

Elizabeth was equally as attentive as her father had been to naval affairs; she ordered that guns of the same calibre should be carried on the same deck in all ships;—she also founded the dock-yard at Chatham. During her reign the chain-pumps, capstans, and other improvements were introduced.

James the First continued the same politic views, and appointed Mr. Phineas Pett, a graduate of the [illegible] Cambridge, to the situation of naval constructor. Th[illegible] built the Prince Royal, Sovereign of the Seas, and other ships, upon scientific principles, and carried naval archi[illegible]ture, during this and the next reign, to a great height.

Mr. Knowles commenced his Second Lecture (*May* 16), by stating,

that the ships during the Commonwealth were not increased in size, but greatly in number, for in nine years the navy was doubled. In 1649 the first frigate which this country possessed was built; she was constructed by Mr. Peter Pett, and called the Constant Warwick; she carried 42 guns, but was only 85 feet long, and 26 feet broad.

The navy was much neglected by Charles the Second; in his reign, however, the first ship to carry 74 guns (the Royal Oak) was built; this ship was 157 feet 6 inches long, and 41 feet 4 inches broad. The dock-yard at Sheerness was commenced at this period.

James the Second paid much attention to the navy; and, with the assistance of Mr. Pepys, carried many wholesome regulations into effect.

At the abdication of James, the fleet was in a good state. William and Mary increased it in numbers; and in order to provide for its future resources, established a dock-yard at Plymouth. At this period the doubling or girdling of ships was first introduced.

Queen Anne gave her whole attention to the efficiency of the army,—the navy was consequently neglected, which caused great murmurs among the people.

George the First increased the size of the ships of the several classes, and took vigorous measures not only to build and rebuild ships, but to repair those left in a bad state by his predecessor.

George the Second still further increased the size of the ships, and added to their numerical force. It was during his reign that the practice of building 80-gun ships on three decks was discontinued, and those of 60 and 50 guns were no longer considered of the line. At the demise of George the Second it was found that the navy had been doubled in real force during his reign.

The ships were much increased in size during the early part of the reign of George the Third, and the constant naval warfare carried on caused a more than ordinary attention to the fleet. In 1783, it was determined that copper bolts and copper nether hinges (called pintles and braces) should be substituted for those of iron; as it was apprehended that several ships had foundered at sea from the oxidation of the iron bolts, in consequence of the ships being copper sh[illegible] was then attributed to the iron being a less pure metal than copper; for it remained for the master-mind of a Davy to discover the physical law, that when two dissimilar metals are in contact, and also with sea water, that a voltaic effect is produced, which occasions a rapid corrosion of the more oxidable metal, while the other remains perfect. "I have great satis-

faction," said Mr. Knowles, " in having the opportunity of mentioning this, from a place in which this brilliant discovery was made, which was alike honourable to the talents of our eminent philosopher, as it is creditable to the liberality of the members of this institution, who afforded the means of his experimenting, by their excellent and extensive apparatus."

After the American war the fleet was put into good condition, and some large and excellent ships built. The Prince, of three decks, was cut asunder, and eleven feet in length added to her midship capacity; the same thing was done to the Hibernia and Ocean, first rates, then building.

In 1793, Mr. Rule (afterwards Sir William Rule) was appointed surveyor; he planned some excellent ships, among which was the Caledonia of 120 guns, which now serves as a model for our first rates. The lecturer eulogised this gentleman as one who possessed every requisite to fill the situation, to which he had been appointed, with credit to himself and advantage to the country. And he remarked that this was " an era in naval science, for a nobleman was appointed by the king to conduct the naval administration of the country, who was initiated in scientific pursuits, and appreciated their influence in the useful arts. In consequence, the talents of Bentham, Brunel, Barrallier, and others of lesser note, were brought into action; our dock yards were improved, the most powerful and useful machines introduced, and some ships constructed upon scientific principles."

" To whom, then, do we owe these and other advantages which our navy and dockyards have derived?—to a nobleman, to praise whom before the members of this institution would be arrogance, as he is above all praise of mine; and as they are so well acquainted with the splendid talents and private worth of their late president, Earl Spencer."

The present method of constructing ships, as invented by Sir Robert Seppings, was compared, step by step, with that formerly practised, and the great advantages shown which have resulted from the use of the diagonal framing in the hold, the shelf-pieces, thick waterways, iron-clasp knees, and truss-pieces between the ports.

The lecture was concluded by showing that all the advantages which naval architecture and naval science have derived at different times, have arisen from the writings or inventions of men of science, and not from mere practicians.

Models of a galley, such as were constructed by Alfred; of the Great Harry, built in the reign of Henry the Eighth; the Sovereign

of the Seas, by Charles the Second; the Bristol, constructed in 1657; the Britannia in 1719, and Caledonia in 1808, were exhibited: also models of Sir Robert Seppings's mode of ship-building, with the round bows and circular sterns.

Some paste models of diamonds, remarkable for their size and brilliancy, and now in the possession of Messrs. Rundell and Co., were on the library table. They had been presented to the Institution by Mr. Bigge.

May 23d.

Mr. Brockedon gave some account of a new method of projecting shot, which had been discovered by Mr. Sieviere the sculptor. Mr. Sieviere had furnished Mr. Brockedon with a report of his earliest experiments, and to some of a later date Mr. Brockedon was an eye-witness. The discovery was accidentally made many years since by Mr. Sieviere, who was one evening amusing himself with a pewter syringe, which he had converted into a cannon, having closed the discharging end of the syringe, and made a touch-hole. Into this cannon he put some pinches of gunpowder, and discharged the piston from it, which fell harmless at a short distance; happening to invert the order of firing by holding the piston, the syringe was discharged with so much violence, as to pass through the ceiling and floor into the chamber above that in which he sat. He was struck with the prodigious difference of effect produced, and immediately had a shot cast, which in form was like a mortar: this he fired from a solid mandrel, or bar swung upon trunnions, and capable of elevation and adjustment. His experiment succeeded so entirely, that he was induced to make a shot with radiant bars, which, though they added little to its weight, added much to its power of destruction to rigging, &c. The weight of this shot, which was of cast iron, was 15 pounds; this was discharged through a bank of clay 6 feet thick, and fell 20 yards beyond it. When fired again, it hit point blank at a distance of 175 yards, and was buried above 3 feet in the bank; the chamber of this shot, with which a touch-hole communicated, was precisely like that of a mortar, and when it was placed for firing upon the mandrel, the shoulder of the chamber at the bottom of the calibre rested upon the end of the mandrel. The chamber contained a charge of 1½ ounce of gunpowder. An experiment was made with a shot which weighed 25 pounds, but a charge of 2¼ ounces of gunpowder was so great as to burst it, and to throw a fragment of 5½ pounds weight to a distance of more than a quarter of a mile. Subsequent experiments with shot of

wrought and cast iron of different forms, confirmed the fact, that shots discharged with the magazine within them were projected with a force greatly exceeding that which the same quantity of gunpowder applied in the usual way would effect.

Mr. Brockedon attempted to account for this greater force by supposing that the power usually wasted in the recoil of the gun, was added to the force by which the shot and mandrel were separated. He stated, that no recoil in common gunnery took place, until the shot had left the cannon; and offered the following proofs of this fact. It is a common practice to fire a cannon suspended from triangles: the mark against which it is directed, being hit, if any recoil had taken place before the ball left the cannon, the ball must have struck some other point tangential to the circle which its point of suspension would describe. Mr. Brockedon mentioned that Mr. Perkins, in the course of some experiments upon recoil, had fastened a loaded rifle barrel to the edge of a horizontal wheel, which moved freely upon a vertical axis; the rifle was directed, and hit the mark, though the recoil whirled the rifle and wheel round with great velocity. Mr. Brockedon illustrated this further, by supposing a boat on still water, and imagining a plank placed from stem to stern, and a man on it pushing with a pole a bundle of hay from him along the plank, the separation of the hay from the man could not affect the situation of the boat on the water, whilst the hay was on board; but if the hay were thrust over, the moment it became independent of the boat, the man and boat would separate from the hay with forces proportioned to their densities.

The space required to contain the products of the combustion of gunpowder, has not been determined by careful experiments, but vaguely stated by some at 500, by others at 1000 times the volume of the powder; taking the lowest statement, and supposing a cartridge to be six inches long, and the length of the gun to be five feet, not more than about $\frac{10}{500}$ of the force generated by combustion operate upon the ball: the remaining $\frac{400}{500}$ths are wasted upon a recoil, which, overcoming the vis inertiæ of the gun with its carriage, (which weighs between three and four tons for a 24-pounder,) will drive it back in garrison service against an inclined plane 18 inches or two feet. The instant the ball leaves the gun the recoil takes place, and the products of combustion, which remain within the gun in a highly condensed and heated state, are opposed in their escape by the vis inertiæ of the external air from which the gun recoils. If recoil were attempted to be explained simply upon action and reaction, by the intervention of a force separating two bodies, whose

resistances were as their densities, then the recoil would prevent any certainty of striking the point or mark against which the cannon is directed; contrary to the effect proved by firing from triangles, Mr. Perkins's experiments, and the practice of every sportsman. The recoil too takes place, whether the firing be with blank or ball cartridge; if the recoil be greater with a ball, it arises merely from the resistance which this offers to the discharge, allowing time for the more complete ignition of the gunpowder, and the generation of a greater force; hence also the effect of a rifled barrel, and the recoil of a foul gun.

The sky-rocket illustrates also this theory of recoil. To increase the surface of the composition exposed to combustion, the rocket is bored conically nearly to its entire depth, the products of this combustion are met by the atmosphere as they rush from the neck of the rocket, and recoil from the resistance; as the cone enlarges, the force increases, and accelerates the ascent of the rocket, poised and directed as it is by the rod. The difference between the effects of the rockets and the shot is, that in the former the force increases from the gradual, but increasing surface in combustion; in the latter, the force is at once generated, and the aid to the force which separates the shot from the mandrel is greatest at first, and though gradually lessening, always adds something to the force of the discharge, until the air within the calibre is equalized with the atmosphere.

The father of the late Sir Wm. Congreve tried some experiments with shot fired from a mandrel; but as he bored the mandrel into which the discharge was put, and did not put the magazine in the chamber of the shot—they failed.

As the expense of trying experiments with Mr. Sieviere's engines is too great for an individual to incur, the probability of its becoming a most destructive engine in warfare ought to recommend it to the serious attention of government. The advantages of the lightness of the mandrel and the unlimited weight of the projectile are immense. When the experiment was made with the 25-pound shot, an invalid watchman carried the cannon shot and ammunition upon his head to Primrose Hill, before breakfast; and the safety of the engine to those employed in its use may be shown in the fact, that the shot which burst did no injury to the gunner; and no mischief could happen: for if the shot burst without advancing from the mandrel, the fragments dispersed at right angles, and if with any projection, in lines resulting from the united forces, leaving the gunner in safety. The recoil of the mandrel is very small, and arises only at the moment of separation from the pressure of the gases, which, escaping

from the calibre, presses upon the end of the mandrel with effect proportioned to its surface.

Some specimens of fulgorites, or the tubes formed in sandy soils by lightning, from Westphalia, were laid upon the tables by Dr. Fiedler, as also some large and rare minerals. The general nature of the fulgorites was explained from the lecture table by Mr. Faraday.

May 30th.

A discourse on the comparative anatomy and physiology of the ear, was delivered in the lecture room by Mr. Curtis.

Several fine pictures and engravings were exhibited in the library, together with some curious autographs from the extensive collection of Mr. Upcott.

June 6th.

Mr. Gilbert Burnett delivered a lecture on sensitive plants, of which the following is an outline.

Every individual of the vegetable kingdom is more or less endowed with motility, as instanced by the raising, drooping, and turning of their leaves to light, the opening and closing of their flowers, &c. &c., which constitute the vigils and the sleep of plants; but, although these motions may be seen in all, in none are they more notorious, perhaps in none more familiar than in the sensitive or humble plants, from which motions the generic name Mimosa has been derived. The M. sensitiva is very rare in Europe; the common sensitive plant of our hot-houses is the M. pudica.

Some of the phenomena exhibited by these plants must have been notorious as long as the plants have themselves been known, such as the rising of the leaflets, the approach of the pinnules, and the collapse of the leaves on the application of any undue stimulus; but these phenomena having been rather the subject of vulgar admiration than of physiological research, at least Mr. Mayo and myself not being aware of any, we agreed to institute a series of experiments to explicate the matter; but in the course of our inquiries, we found that, in some of our experiments, we had been anticipated by Dr. Dutrochet; and having been led by a slight notice in Smith's Introduction to Botany, to consult a paper sent by Mr. Lindsay from Jamaica, and read to the Royal Society, A.D. 1790, but not published, we were surprised to find, that in the very experiments in which we had been forestalled by Dutrochet, had Dutrochet been

anticipated by Lindsay, but each pursued the inquiries with a different view, and partly in a different course.

The result of these collateral experiments had been to prove, that the tuber at the articulation of each leaf with the stalk, is formed by antagonist elastic springs, the superior serving to depress, the inferior to elevate the leaf; for if the upper part of the intumescence be cut through, the leaf rises more than natural, and no irritation, however violent, can cause it to collapse; that if the under part be divided, the leaf falls, and by no extent of rest will it again be enabled to rise; also the lateral parts being cut, a lateral flexion is caused towards the wounded side.

Similarly acting organs exist at the articulations of the pinnules, and of the leaflets, only in the one case they are placed laterally, and in the other diametrically opposite to their position on the leaf stalk; their motions are in accordance with this change of place, and by similar operations may be interrupted.

Experiments were performed to show what would ensue from the isolation of different parts; branches, leaves, leaflets, &c., were entirely removed from the plants, and yet their motive powers remained; the pinnules were separated from each other by longitudinal and transverse incisions, and the leaflets on each side of a pinnule separated by a long incision, by which the course and the progress of the irritation could be traced. The under sides of several leaves and leaflets were blackened, and by thus preventing the access of light, the collapse became greatly prolonged; from these and other experiments, the following conclusions may be drawn:

1. That plants possess motility.
2. That the motive power is resident in each part, independent of its communion with the rest of the plant.
3. That although a connexion may exist, for the performance of these motions, no communication with any common centre is required.
4. That there is no evidence of any structure similar to what may be truly called a nervous system in animals; and that if any system analogous exist, it must be in a very rudimental state.
5. That plants are destitute of sensation and volition, i. e. there is no such thing as "perceptivity" among vegetables.

The perceptivity of plants has been inferred, and a nervous system presumed to exist, from certain curious phenomena, as the course of the radicle and plumula, the direction of roots, the climbing of voluble stems, the increase and loss of defensive armour in prickly and thorny shrubs, &c. &c. which may better be explained as the

effects of specific stimuli; these are all evidences of design, yet of design exterior to the individual; but it would seem that the chief evidence in favour of a nervous system, or something analogous to it, being present in plants, may be drawn from the circumstances, 1. of their being destroyed by the same poisons which cause death in animals, by action on the brain and nerves;—2. by certain corpuscles discovered by Dutrochet, being concrescible and soluble by the action of acids and alkalies, in the same manner as the nervous substance in animals; and—3. by plants maintaining a temperature different from that of the surrounding medium, as shown by numerous experiments. It may also be added, that plants (especially when a little faded) are revived by certain stimuli, such as camphor, ammonia, &c., which, it is believed, stimulate animals through the medium of their nerves.

June 13th.

Mr. Faraday gave an account of the recent and present state of the Thames Tunnel, including a particular account of the circumstances which have so far influenced its progress; of the irruptions of water; of the perfection of the finished work; and the means by which it is intended to be completed.

These evening meetings were then adjourned to next year.

The following Courses of Lectures have been delivered in the Amphitheatre of the Royal Institution during the present session:

On the Chemistry of the Metals, by W. T. Brande, Esq., F.R.S. London and Edinburgh, Professor of Chemistry in the Royal Institution.

Lecture I. *Saturday, February 2nd.* General Remarks on the importance and uses of the Metals, with an Outline of their Natural and Chemical History. Metals known to the earliest Inhabitants of the Earth—Native Metals—Rude Processes by which some of their Ores are reduced. Metals discovered by the Alchemists, and in the dark ages. Speculations concerning their Nature—Discoveries of the Metallurgical Chemists of the 16th and 17th Centuries—Influence of more refined Chemical processes upon these discoveries—New Views in relation to the subject developed by Sir H. Davy's Electro-Chemical Researches.

Lecture II. *Saturday, February 9th.* Geological History of the Metals. Alluvial deposits containing them—Structure and Situation of Metallic Veins—Modes of discovering and working them—Average produce of the principal British Mines. Peculiarities in respect to Iron Works. Difficulties and uncertainties attendant on all Mining Speculations.

Lecture III. *Saturday, February 16th.* Chemical History of the principal Metallic Ores. Arrangement of them in reference to their Composition—Alloys—

Oxides—Sulphurets—Processes by which these are decomposed, so as to yield pure Metals—Operations of the Assayer and Analyst—Smelting and reduction upon the large scale—Proposals for the consumption of the Smoke and noxious Vapours resulting from these operations.

LECTURE IV. *Saturday, February 23rd.* Physical Characters of the Metals—Brilliancy—Opacity—Specific Gravity—Ductility—Tenacity—Malleability—Conducting and radiating Powers in respect to Heat—their electric and magnetic relations.

LECTURE V. *Saturday, March 1st.* Chemical Characters of the Metals—How affected by Air and Water—Influence of Heat and Electricity upon these agencies—Oxydizement of Metals by the preceding Agents and by Acids—Properties and Uses of the principal metallic Oxides.

LECTURE VI. *Saturday, March 8th.* Metallic Chlorides—Iodides—Fluorides—Bromides—Metallic Salts—Applications of these Compounds to various purposes of the Arts.

LECTURE VII. *Saturday, March 15th.* Of the Tests or Re-agents by which the different Metals are recognised and detected—Extraordinary delicacy of some of them—Of the Means of detecting the poisonous Metals, and of the uncertainty of some of the Methods which have been proposed. Articles of Food subject to metallic adulteration.

LECTURE VIII. *Saturday, March 22nd.* Of metallic Alloys—Peculiar properties of many of them—Ancient and Modern Coins—Plate—Precautions to preserve an uniform Standard—Mirrors—Bronze—Brass—Bell-Metal—Pewter—Type Metal—Tin Plate—Fusible Alloys—Intense action of certain metallic Compounds upon each other. Nature and properties of Steel.

LECTURE IX. *Saturday, March 29th.* Of Alkalies and Earths—Properties and Uses of the former--Soaps—Combinations of the Alkalies and Earths—Earthenware—Pottery—Porcelain—Glass—Hypothesis respecting the Nature of the Metals—Conclusion.

On Domestic and Ecclesiastical Architecture. By Alfred Ainger, Esq.

LECTURE I. *Tuesday, February 19th.* On the Sources of Beauty in Architecture.

LECTURE II. *Tuesday, February 26th.* On the Strength and Employment of Materials in Architecture.

LECTURE III. *Tuesday, March 4th.* On the Means of increasing Strength by Disposition and Arrangement.

LECTURE IV. *Tuesday, March 11th.* The Application of these Principles to Egyptian and Grecian Architecture.

LECTURE V. *Tuesday, March 18th.* To Roman and Palladian Architecture.

LECTURE VI. *Tuesday, March 25th.* To Gothic and Miscellaneous Architecture.

On Music. By Samuel Wesley, Esq.

LECTURE I. *Thursday, February 21st.* On the Acquisition of a sound *general* Knowledge of Music.

LECTURE II. *Thursday, February 28th.* Of the best Mode of acquiring solid Judgment concerning the various Styles in both Vocal and Instrumental Music.

LECTURE III. *Thursday, March 6th.* On Music best adapted to the Chamber.

LECTURE IV. *Thursday, March 13th.* On Music most proper for Concerts.

LECTURE V. *Thursday, March 20th.* On Theatrical Music.

LECTURE VI. *Thursday, March 27th.* On Church Music.

On the Application of Mechanical Philosophy to the Manufactures of Great Britain. By John Millington, Esq., F.L.S., Professor of Mechanics in the Royal Institution.

Lecture I. *Tuesday, April 15th.* Introduction, and Objects of the Course. On the Manufacture of Fabrics; and first, of Linen. Enumeration of those Vegetables which yield the best Fibres. The respective advantages of Hemp, Flax, and Bean Stalks, with some account of the Culture and Management of these Plants. Treatment of Hemp and Flax preparatory to converting them into Threads.

Lecture II. *Tuesday, April 22nd.* Of Heckling Hemp and Flax, and Spinning them by Hand. Of Spinning by Mill or Machinery. Arkwright and Kay's Machinery for this purpose. Particulars of Mill Spinning, and the production of Yarns.

Lecture III. *Tuesday, April 29th.* On the use and appropriation of the Tow, or refuse materials of the above processes. On Cotton, Silk, and Wool, with the several modes of preparing them, and converting them into Thread.

Lecture IV. *Tuesday, May 6th.* On Weaving the above Materials into Cloths or Fabrics. Hand and Power Looms. Of simple Weaving, Twilling, and the production of Figures or Patterns.

Lecture V. *Tuesday, May 13th.* Weaving continued. Ribbon, Velvet, and Carpet Work. Production of Lace by Machinery.

Lecture VI. *Tuesday, May 20th.* Of the finishing of Fabrics after they are woven, by dressing, burning, singeing, cutting or shearing, embossing, &c., by which they derive their final beauty and lustre.

Lecture VII. *Tuesday, May 27th.* Of Dyeing and Printing Patterns upon the surfaces of woven Fabrics, Calico Printing, &c., and of watering, crimping, and otherwise ornamenting the surface of goods.

Lecture VIII. *Tuesday, June 3d.* On the Manufacture of Earthen goods by the agency of Fire. Preparation and selection of the Earths, with their mode of Treatment to form Bricks, Tiles, Vessels of Earthenware, and Porcelain of various kinds.

Lecture IX. *Tuesday, June 10th.* Same Subject continued. On Glass making. On the Art of Enamel Painting, and Painting upon Porcelain with vitrifiable colours. Conclusion of the Course.

On Painting and the Fine Arts. By R. R. Reinagle, Esq., R.A.

Lecture I. *Thursday, April 17th.* The History of the Arts, from their earliest appearance, and gradual advancement to perfection; motives and incentive causes of their extraordinary rise and perfection in Greece. Examination of the excitements which gave birth, and brought to maturity the Art of Painting in Italy, at the brilliant period of Julius the Second and Leo the Tenth. The Arts of the early and later times compared, in order to establish grounds for just criticism. Object of taking this view of the subject, viz.. to appreciate the merits of Art, and to point out the benefits, honours, and advantages that must result from an established cultivation of the Fine Arts generally, in a country like England.

Lecture II. *Thursday, April 24th.* The Science of Lines. First ideas of form; causes of character in every visible object. The property and importance of Lines to all natural or artificial things. On Geometrical Figures and Diagrams; causes why every thing Beautiful, Elegant, Simple or Grand, is dependent upon Geometrical forms. Various illustrations were produced in the course of this Lecture from the Elgin Marbles, Etruscan and Greek Vases, Alto and Basso Relievos, Raphael, &c.

Thursday, May 1st, being the Annual Meeting of the Members of the Royal Institution, there was no Lecture on that day.

Lecture III. *Thursday, May 8th.* The early and important discovery, by the Ancient Greeks, of the value and consequence of the knowledge and application of

Geometry to the Arts. Perspective, how connected with regular Lines. Aerial Perspective. Colours. Their real number and absolute character. How primitives are ascertained. What are the Compound Colours. The association, simplicity, opposition, harmony, and discord of Colours, illustrated by Diagrams of a novel character. How Colours have been employed by the different Schools, and have become characterised so as to be distinguished.

Lecture IV. *Thursday, May 15th.* On Chiaro Oscuro, or Light and Shade. Its influence on subjects that demand it, and on others that do not. The Masters who have excelled in this Science. Those who have erred. On the sublime powers of this Science. The consequence of the want of effect in the Stanzas of Raphael. The great knowledge Rembrandt had of this powerful part of the Art.

Lecture V. *Thursday, May 22nd.* On Composition and Invention. The distinction to be made. Of the varieties of Composition and Invention. The fine taste of the Greeks in the art of Composition. The Artists who have excelled most in Scientific disposal of subjects. The principles of Leonardo da Vinci, Raphael, Michael Angelo, the Caracci, Domenichino, Guido, Albano, Nicolas Poussin. The graces and mysteries of Science connected with Art. On Style and Manner, with their consequences. Illustrations.

Lecture VI. *Thursday, May 29th.* On Expression, Grandeur, Sublimity, Simplicity, Grace, and Beauty. Illustrations from Michael Angelo, Raphael, Correggio, and other Masters of eminence. Descriptions of some of the magnificent works of the Ancients. Those of Phidias, Apelles, Zeuxis, &c. Causes why the Phigalian Marbles, though ill executed, and worse proportioned, are considered by Amateurs as noble works. Retrospective Sketch of the foregoing Lectures.

On the Natural History of Fishes. By J. Harwood, M.D., F.R.S., F.L.S., Professor of Natural History at the Royal Institution, &c.

Lecture I. *Friday, April 18th.* Peculiarities in the general Structure of Fishes—their Organs of Motion, and of Sense—great Division of the Class—the Cartilaginous Tribes—Structure and Economy of the Lampreys, and Shark genera.

Lecture II. *Friday, April 25th.* Cartilaginous Fishes continued—Sharks—Rays—Torpedos—Sturgeons—Bony Fishes—Diodons—Tetrodons, &c.

Lecture III. *Friday, May 2nd.* Structure, and general Economy of Bony Fishes—Soft-finned Abdominales—Salmons—Trouts—Fisheries—Herring genera, &c.

Lecture IV. *Friday, May 9th.* The Abdominales continued—Pike and Carp Families, and genera—Gold Carp—Silurus, &c.

Lecture V. *Friday, May 16th.* The Jugulares—Cod Tribe—Fisheries—Flat Fishes—Sea Fishes naturalized in Fresh Water.—Sucking Fishes—Lump—Remora—Apodal genera—Eel—Murænæ, &c.

Lecture VI. *Friday, May 23rd.* Spiny-finned Fishes—Perch—Mullet—Wolf Fish—Gurnet—Mackarel—Dory—Chætodon, &c. &c.—Conclusion of the Course.

On the Operations of the Laboratory. By Michael Faraday, Esq., F.R.S., Corr. Member of the Royal Academy of Sciences, Paris, Director of the Laboratory, &c. &c.

Lecture I. *Saturday, April 19th.* General Nature of Laboratory Operations—Utility of Mechanical Division—Methods of effecting it—Separation of Powders—Influence of Division over Chemical processes.

Lecture II. *Saturday, April 26th.* Relation of Mechanical Division to Solution—Solubility—its Nature and Advantages—Solution effected, modified, and applied.

Lecture III. *Saturday, May 3rd.* Solution continued—Digestion—Nature and Advantages of Crystallization—Its applications in Chemistry.

LECTURE IV. *Saturday, May 10th.* Processes of Distillation—Application of Heat—of Cold—Distillation of Solid Bodies, or Sublimation.

LECTURE V. *Saturday, May 17th.* Precipitation of Substances from a state of Solution—important use of this Process—Precautions.

LECTURE VI. *Saturday, May 24th.* Separation of Precipitates—Filtration—Decanting operations—Fluids separated.

LECTURE VII. *Saturday, May 31st.* Processes of Evaporation—Tests of Dryness—drying Operations.

LECTURE VIII. *Saturday, June 7th.* Coloured Tests—their general nature, application, and uses.

On Botany. By Edmund John Clark, M.D., F.L.S., M.R.I.

LECTURE I. *Wednesday, May 7th.* Introductory Sketch of the Progress and Utility of Botanical Science—Simplicity of the Arrangement—Advantages of Linnean Classification—Examples, &c.

LECTURE II. *Wednesday, May 14th.* Linnean Classification further illustrated and exemplified—Physiological Suggestions—Natural Divisions, &c.

LECTURE III. *Wednesday, May 21st.* Linnean Classification continued—Connexion with Botanical Physiology—Vegetable Structure further considered.—Peculiar Organizations. Philosophy of final Causes, as exemplified in the Vegetable Kingdom.

LECTURE IV. *Wednesday, May 28th.* Further Relations of Botanical Science—Anomalous Structures—anticipated Improvements—Connexion with Therapeutics—Practical Observations—Conclusion.

On Hieroglyphics. By the Marquis Spineto.

LECTURE I. *Friday, May 30th.* Introduction—Necessity of prior Explanations—Difficulties of Hieroglyphics—Requisites for understanding them—History—Religious Doctrines—Antiquities; Thebes, Memphis, Abydos, &c.

LECTURE II. *Friday, June 6th.* Opinions of the Ancients concerning the Nature and Use of Hieroglyphics—Erroneous Judgments of the Moderns—Scarcity of Monuments—The Rosetta Stone—Discoveries made by M. de Sacy, Ackerblad, Dr. Young—Enchorial Alphabet—Attempt at decyphering Hieroglyphics—Reflexions.

LECTURE III. *Wednesday, June 11th.* Continuation of the same Subject—Discovery made by Mr. W. Banks—Champollion's Letter to M. Dacier—Précis du Système Hiéroglyphique—Hieroglyphical Alphabet—Number of Characters—Illustrations—Disposition of Signs—Examples—General Rules—Application of the Alphabet to the reading of the Names of Egyptian Princes under the Romans, the Greeks, the Persians, the Pharaohs—Coincidence between the Bible and some of these Legends.

LECTURE IV. *Friday, June 13th.* Division of Hieroglyphics—Explained—Legends of some of the principal Deities—Characters of some of them as the Rulers of the Æmenti—Account of the Regions to which the Souls of the Dead might be sent—Mode by which they were tried—Important Tenets it inculcated—Origin of the Tartarus, the Elysium—Pluto—Cerberus—Charon, &c.

LECTURE V. *Wednesday, June 18th.* Continuation of the same Subject—Exhibition of a curious Specimen—Further examination of Hieroglyphics—Grammatical Forms—Genders—Numbers—Verbs— Pronouns — Mixture of Signs—Legends—Mystic Titles, or prænomen assumed by the Egyptian Princes—Coincidence of the Egyptian Inscriptions with the Names of some of the Kings mentioned in the Bible.

LECTURE VI. *Friday, June 20th.* The Subject continued—Legend of Rameses Illei-amoun round the Cover of the Sarcophagus in Cambridge—Explanation—Antiquity of the Monument—Reflexions on Chronology—Table of Abydos—Discoveries of Champollion—The Hik-shog, or the Shepherd Kings.—Conclusion.

The Anniversary Meeting of the Royal Institution, for the election of a President and other Officers, was held, as usual, on the 1st of May. The following was the result of the ballot.

President—Duke of Somerset, F.R.S.

Treasurer—Sir S. Bernard Morland, Bart., M.P., LL.D.

Secretary—Edmund Robert Daniell, Esq.

Managers.

Barclay, Charles, Esq., M.P.
Cabbell, Benjamin Bond, Esq., F.S.A., V.P.
Colebrooke, Henry Thomas, Esq., F.R.S. and F.L.S.
Duckett, Sir George, Bart., F.R.S. and F.S.A.
Goldsmid, Isaac Lyon, Esq., F.R.S.
Jekyll, Joseph, jun., Esq.
Moore, George, Esq., F.S.A., F.L.S.
Murchison, R. I., Esq., Sec. G. S.
Nicholl, Whitlock, M.D., M.R.I.A., and F.L.S.
Pepys, William Hasledine, Esq., F.R.S.
Pilgrim, Charles, jun., Esq.
Sabine, Capt. Edward, of the Royal Artillery, Sec. R.S.
Scott, Sir Claude, Bart., F.L.S., and F.H.S., V.P.
Somerville, William, M.D., F.R.S.
Sterling, Edward, Esq.

Visitors.

Bernard, Thomas Tyringham, Esq.
Broadwood, James M., Esq.
Brooke, Arthur de Capel, Esq., F.R.S.
Carrington, Lord, F.R.S.
Daniell, John Frederic, Esq., F.R.S.
Disney, John, Esq.
Darnley, Earl of.
Fuller, John, Esq.
Gilbert, Davies, Esq., M.P., Pres. R.S., and F.A.S.
Hoblyn, Thomas, Esq.
Knight, Henry Gally, Esq.
Long, George, Esq.
Rule, William Noble, Esq.
Smith, George Stavely, Esq.
Solly, Richard Horsman, Esq., F.R.S. and F.S.A.

ASTRONOMICAL AND NAUTICAL COLLECTIONS.

i. Astronomical Chronology, *deduced from* Ptolemy, *and his Commentators.*

Year

1 of the Canicular cycle, called by Theon, (MS. "2390") as cited by Larcher and Champollion Figeac, the epoch of *Menophres*, is ascertained by the testimony of Censorinus, chapters 18 and 21; he says that the 986th year of Nabonassar, in which he wrote, was the 100th of the canicular cycle of 1461 Egyptian years: the first year of that cycle, which may be called the 1462d of the preceding cycle, was consequently the 887th of Nabonassar, and the 1st of Nabonassar the 576th of that cycle, which began 575 Egyptian years before the epoch of Nabonassar, or as many tropical years wanting 139.3 days; and, this epoch having been determined to be $\odot_{\Upsilon} - 746^{y} - 30.4^{d}$ (Collections for April, 1828), in true equinoctial time, the date was nearly

$$\odot_{\Upsilon} - 1321^{y} + 108.9^{d}.$$

It appears from Censorinus, that the canicular period began when the 1 Thoth was the 20th July. The number of years allotted to it seems to have been very simply deduced from the supposed length of the true year, as consisting of $365\frac{1}{4}$ days, without any knowledge of the distinction between the tropical and the sidereal year: and it commenced when the apparent heliacal rising of Sirius was on the first day of the Egyptian year; the sun being supposed to be about ten degrees below the horizon. Professor Ideler has shown (Halma's Ptolemy III., p. 31, 38) that this occurred on the 1 Thoth in − 1321 as well as in + 139, exactly at the interval of 1460 tropical years; but that in +1599 it must have happened about two days later: and he very truly observes, that there was nothing in this phenomenon that could serve to establish or to correct the supposed length of the year, deduced, as it must have been, from the regular return of the seasons.

The nature of the heliacal rising of the stars is illustrated by a passage of Geminus (Halma, p. 57.) "The heliacal risings of the stars are either true or apparent: the true are when the sun and star are at the same instant on the horizon; but these are not visible, on account of the strength of the sun's light. The sun, however, moving gradually among the stars from west to east, the given star will rise every morning afterwards a little more and more before the sun; when it has become so remote from it as to be visible, the star is said to be at its apparent heliacal rising: and in this manner the risings are predicted and are observed." "It is a vulgar prejudice," he continues, (p. 67) "to suppose that the rising and setting of the stars have any influence on the atmosphere:

Year

they are far too remote for the clouds to come within their reach. The weather has been observed at certain times of the year, and the places of the sun at these times having been noted, the rising and setting of the stars have been employed as marking those places and those seasons only: and a lighted beacon might as well be called the cause of a war, as the appearance of the stars the cause of a change of weather. And since the sun has been about 40 days in the neighbourhood of the tropic, about the time of the rising of the dog-star, the coincidence serves to mark the hottest time of the year, without giving the dog-star any claim to be the cause of heat: and in fact it is the time of the apparent heliacal rising that we remark: not that of the true rising, as it ought to be, if any immediate operation of the stars were concerned."

Mr. Champollion Figeac has attempted to go back to the era of Menophres, in order to bring down from it, by the testimony of miscellaneous authors respecting some facts of very high antiquity, the dates of the series of reigns enumerated by Manetho. But unless we prefer these authorities to that of Manetho himself, we gain nothing by this substitution. The name of " Menophres" cannot be identified with any kind of certainty among Manetho's kings: while the date of the reign of Darius is as well ascertained as that of the accession of Lewis the 14th: and this reign belongs as clearly to Manetho's 27th dynasty, as to Ptolemy's records of eclipses.

Egyptian year of Nabonassar

1, Thoth (I.) 1; true noon at Alexandria. This is the general epoch of Ptolemy's tables, except those of the stars, which are reduced to the first year of Antonine. His mean solar time is reckoned from the true time of this epoch.

In order to proceed with regularity in the computation of the correct date of the epoch, it will be necessary to anticipate some of the observations of Hipparchus: premising also a table of the length of the true tropical year, beginning from the reign of Nabonassar, according to the numbers lately employed by Mr. Poisson, which afford us, for any number x of years beginning about this time, $365.2423854x - .000000033275x^2$, for the days that they contain. Hence, if we include in the variation of the time of the true equinox, as shown in the Supplement to the Nautical Almanac for 1828, we obtain the number of days wanting in the Egyptian years.

Egyptian years.	Days wanting of m. tr. years.		Corr. of true E.	Sum.
100	24.23851	(−.000333	−.01)	−.010
200	48.47708	.001331	.05	.051
300	72.71562	.002995	.07	.073
400	96.95416	.005324	.09	.095

Egyptian year of Nabonassar.

Egyptian years.	Days wanting of m. tr. years.		Corr. of true E.	Sum.
500	121.19270	.008319	.12	.128
600	145.43124	.011979	.15	.162
700	169.66998	.016304	.17	.186
800	193.90832	.021296	.18	.201
900	218.14686	.026955	.19	.217
1000	242.38540	.033100	.20	.233
2000	484.77080	.133100	.20	.333
2500	605.96350	.207975	.19	.398

The principal observations of the vernal equinox, made by Hipparchus, were in the years
602, Mechir 27, 2h. before N.; 601ʸ 175.917ᵈ – 145.512ᵈ,
613, Mechir 29, 12h.; 612ʸ 178.[illegible] – 148.176ᵈ.
620, Phamenoth 1, 6h.; 619ʸ 180.25ᵈ – 149.870ᵈ.
the first gives 30.405, the second 30.324, and the third 30.389 for the time of the vernal equinox in the first year of Nabonassar: the mean being 30.366. But the two latter observations being confirmed by their coincidence with those of the intervening equinoxes, they must be allowed to preponderate in some small degree, and we must call the most probable mean about 30.360, and the epoch

☉♈ – 746ʸ – 30.36ᵈ.

It can hardly be supposed, however, that this number is much more decidedly accurate than 30.40; but some further corrections might possibly be obtained from the early eclipses, if greater precision were of any importance.

1, Paophi (II.) 1, at 9½h., was consequently the eq. ☉♈ – 746ʸ.

27, Thoth (I.) 29, 2½ hours before midnight at Babylon was the middle of a total lunar eclipse, which lasted in the whole four hours. (Ptolemy, p. 95, Ed. B. p. 244, II.) The interval is 26 E. y. $28\frac{21}{48}$ days, allowing for the difference of longitude; the days wanting 6.29; and the whole time elapsed 26ʸ 22.15ᵈ, making ☉♈ – 720ʸ – 8.21ᵈ.

Ideler has computed the time of this eclipse from Mayer's tables, and finds the beginning a minute later, the end six minutes earlier than the observation recorded by Ptolemy. Bürg's tables agree much less accurately: but still later astronomers have corrected the node nearly in the manner that Ideler has suggested. The sun's true longitude is made by Ptolemy 354° 30′.

"This was the 1st year of Mardoc Empadus."

28, Thoth (I.) 18, at the midnight of Babylon, was the middle of a lunar eclipse of three digits. (P. 95, B. p. 245 II.) Now 27 E. y. 17.46ᵈ are 27 eq. y. 10.93ᵈ; whence we have

☉♈ – 719ʸ – 19.43ᵈ.

Egyptian year of Nabonassar.

Ideler makes the middle 48 minutes earlier than the recorded time, and the magnitude only 1½ digit. (H. IV. 172.)

28, Phamenoth (VII.) 15, 3½h. before midnight at Babylon, somewhat more than 6 digits on the moon's northern limb were eclipsed. (p. 95, B. p. 245, H.) The date is 176.7^d later than that of the preceding observation, or ☊ $-719^y+157.3^d$.

Ideler finds the time, assigned to the middle, 12 minutes too early.

127, Athyr (III.) 27, 17h. true Alexandrian time, 16¾h. mean time, reckoned from the epoch of the tables, the middle of an eclipse of 3 digits on the moon's southern limb was observed at Babylon. (p. 125, B. p. 340, H.) Now 126 E. y. 86.7^d require a correction of 30.52^d, leaving 126^y 56.18^d, which makes ☊ $-620^y+25.82^d$.

Ideler finds the middle 1h. 4m. earlier, and the magnitude only 1½ digit.

The year was the 5th of Nabopolassar, consequently the 1st of Nabopolassar was the 123rd of Nabonassar.

225, Phamenoth (VII.) 17, 1 hour before midnight at Babylon, the moon was eclipsed half a diameter on the northern limb, (p. 125, B. p, 346, H.) For 224 E. y. 6m. 14 days, the correction is 54.24^d, leaving 142.16: ☊ $-522^y+111.80^d$.

Ideler makes the time of the middle 11¼h.; the magnitude as observed.

This year was the 7th of Cambyses; whence the 1st of Cambyses was the 219th of Nabonassar.

246, Epiphi (XI) 28, 10¼h., Alexandrian time, the moon eclipsed ¼ of a diameter on the south side, according to the records employed by Hipparchus: the moon being near the apogee. The correction is 59.56^d, for 246 E. years, of which the interval wants 37.36^d. ☊ $-500^y-127.28^d$.

P. 102, B. p. 269, II. Ptolemy observes that the date is 218 E. y. 309d. 23h. 12m. after the eclipse in the second year of Mardoc Empadus. Ideler finds the middle 12 minutes later than the observation, and the magnitude 2 digits only.

The year was the 20th of Darius, the successor of Cambyses; whence the last of Cambyses must have been the 226th of Nabonassar, which was also the eighth of Cambyses.

257, Tybi (V.) 3, 10h. 30m. true time at Alexandria, or 10h. 15m. mean time reckoned from the epoch, the moon was eclipsed 3 digits (p. 102, B. p. 267, H.): the 31st Darius I. Correction 61.99^d. ☊ $-490^y+30.09^d$.

Ideler makes the middle 35 minutes earlier, the magnitude 1 digit (H. IV. p. 177).

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316, Phamenoth (VII.) 20-21, (p. 62, B. p. 162, H.) The summer solstice, roughly observed by Meton and Euctemon, is recorded as having occurred when Apseudes was archon of Athens, in the morning of the 21st Phamenoth: from this observation to that of Aristarchus in the 50th year of the first period of Calippus, according to Aristarchus himself, there were 152 years; and this 50th year was the 44th from the death of Alexander: it was 419 years earlier than that of Ptolemy made in the 463rd year after Alexander: so that from Meton to Ptolemy there were 571 years. Now the 476th of Nabonassar is called the 52nd from the death of Alexander (p. 252, B.); and the 468th would be the 44th; whence, deducting 152, we have 316; and the correction 76.27^d, giving ☉♈ $-431^y+94.12^d$.

The interval between the vernal equinox and the solstice, as assigned by Hipparchus and Ptolemy, was 94½ days: at present it is 92.9.

The first year of Calippus must have been *about* the 419th of Nabonassar. See 547.

The names of the Archons, mentioned by Ptolemy, are found in their proper places in the Anonymous Catalogue of the Olympiads, not improbably compiled by Africanus, and published in Scaliger's Eusebius.

366, Thoth (I) 26—7, (p. 105, B. p. 275, H.) According to Hipparchus, a lunar eclipse was observed at Babylon, of which the middle was apparently 18½ hours, "correctly" 18¼, after the Alexandrian noon of the 26th Thoth. ☉♈ $-381^y-92.98^d$.

This was in the 6th Athenian month Posideon, near the winter solstice: Phanostratus being archon.

366, Phamenoth (VII.) 24, (p. 105, B. p. 276, H.) A lunar eclipse observed at Babylon; the middle at 8h. 15m. Alexandrian mean time apparently; but correctly at 7h. 50m.: the whole duration about 3 hours. ☉♈ $-381^y+84.59^d$.

Phanostratus was still archon: the month being Scirrhophorion, which was the 12th of the Athenian year, preceding the summer solstice.

Both these eclipses are mentioned in the Catalogue of the Olympiads, as having occurred in the 394th Olympic year, which must therefore have commenced about ☉♈ -382^y+94^d, and ended about ☉♈ -381^y+94^d: and, deducting 393, the first Olympic year began ☉♈ -775^y+94^d: so that we may find the equinoctial year by deducting 776 from the Olympic year, and adding 776 to the equinoctial date at midsummer, we have the corresponding Olympic year, which begins about that solstice: for instance, at the midsummer of 1828, we have the

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beginning of the Olympic year 2604; or, according to the Connoissance des Tems, in July, 1828; and indeed Ptolemy mentions a solstice as occurring towards the *end* of an Athenian year.

367, Thoth (I.) 16, (p. 106, B. p. 278, H.). The middle of a lunar eclipse observed, at Babylon, at 10h. 10m. apparent, or 9h. 50m. correct Alexandrian time: the interval being 366 E. y. 15.4 days: correction 88.62d. ☉♈ −380y − 103.58d.

This was in the month Posideon the earlier, Evander being archon at Athens.

418. The first year of the first period of Calippus. The Catalogue of the Olympiads, CXII. 2, has the "Battle of Arbela: beginning of the periods of Calippus of Cyzicum." The year of Calippus probably began with the Olympic or Athenian year: and the 50th ended in 468; consequently the first ended in 419. See 597.

425, Thoth 1. The first year after the death of Alexander; begins See 316.552. ☉♈ −322y − 133.03d.

438. The first year of the "Chaldean era."—See 504. Of this era little or nothing more is known.

454. Paophi (II.) 16, (p. 171, B. vol. 2, p. 26, H.) Timocharis says that he observed at Alexandria, in the 36th year of the first period of Calippus, on the 25th of Posideon, at the beginning of the 10th hour of the night, that the moon exactly touched, with her northernmost point, the northern star in the forehead of the scorpion: the longitude of the star, reckoned from the autumnal equinox, being 32°, and its latitude 1° 20′ N. The year was the 454th of Nabonassar, the days elapsed 45.62: the corection 109.69, giving ☉♈ −*293y* − *94.43d*.

454, Tybi (V.) 5, (p. 170, B. vol. 2, p. 23, H.) Timocharis writes that he observed at Alexandria, in the 36th year of the first period of Calippus, the 15th of Elaphebolion, at the beginning of the 3rd hour of the night, that the moon touched Spica with her eastern limb, the star cutting off exactly one third of a diameter on the north: the year being the 454th of Nabonassar: the star's longitude from the tropic of Cancer being 82° 20′; its latitude 2° south: the time Tybi 5, 8h.
☉♈ −293y − 15.72d.

464, The first year of Dionysius. See 476..507. This astronomer named his months from the signs of the zodiac, and of course employed the true length of the year, as far as it was ascertained. He is said to have allotted to it 365d, 5h. 49m.; and to have made it begin the 26th June; but perhaps without any very good authority; for his determination of the year

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could scarcely have been unknown to Ptolemy. This was the first year of Ptolemy Philadelphus.

465, Athyr (III.) 29, (p. 169, B. vol. 2, p. 21, H.) Timocharis writes that he observed in Alexandria, the 47th year of the first Calippic period of 76 years, on the 8th of Anthesterion, or the 29th of the Egyptian month Athyr, $3\frac{1}{3}$ hours before midnight, the moon in ♉ 0° 20′; her southern half occulted the following third or half of the Pleiades: the extremity of the Pleiades being in ♈ $29\frac{1}{2}$°, and in nearly 3° 2′ N. lat.
☉♈ $-282^{y}-54.35^{d}$.

466, Thoth (I) 7, (p. 170, B. vol. 2, p. 24, H.) Timocharis continues, that in the 48th year of the same Calippic period of 76 years, on the 26th of Pyanepsion, which was the 7th of Thoth, about $14\frac{1}{2}$h., the moon, just after her rising, touched the star Spica at her northernmost limb: the latitude of the star was 2° S.; its longitude $172\frac{1}{2}$°. These two observations of Spica give the precession 10′ in 12 years, as they ought to do, according to more modern experience. ☉♈ $-281^{y}-136.34^{d}$.

468, (p. 62, 63, B. p. 162, 163, H.) Aristarchus observed the summer solstice at the end of the 50th year of the first Calippic period; that is, according to Hipparchus, 152 years after Meton and Euctemon, or in the 44th from the death of Alexander, which was the year 468 of Nabonassar. See 316. About ☉♈ $-279^{y}+94^{d}$.

476, Athyr (III.) 20, (p. 252, B. vol. 2, p. 226, H.) In Dionysius's 13th year, the 25th of his month Aegon, the planet Mars came close to the northernmost star in the forehead of the scorpion; this was in the 52d year after the death of Alexander, or the 476th of Nabonassar; the 20-21 of the Egyptian month Athyr, toward sunrise: the star being in ♏ 2° 15′. ☉♈ $-271^{y}-65.62^{d}$.

476, Mesore (XII) 17. (p. 242. B. vol. 2. p. 205. H.) Timocharis records an observation made in the 13th year of Philadelphus, on the 17-18th of Mesore; Venus passed exactly over the star opposite to the forerunner of Vindemiator, which is the star following the star at the end of the southern wing of Virgo, the year being the 476th of Nabonassar; the time near sunrise. ☉♈ $-271+201.38^{d}$.

It follows that the first year of Philadelphus was the 464th of Nabonassar, or the 40th after Alexander. The astronomers seem not to have continued to date from the epoch of Ptolemy Soter so long as the medals.

484, Thoth (I) 18. (P. 237. B. vol. 2. p. 187. H.) In the 21st year of the era of Dionysius, which was the 484th of Nabonassar, on the 22d of the month which he calls Scorpion, or the

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18-19th of the Egyptian month Thoth, in the morning: the planet Mercury was at the distance of the moon's diameter from a line passing through the northern and the middle star in the Scorpion's forehead, and was two diameters to the north of the northernmost. ☉♈ $-263^y - 129.56^d$.

486, Choeac (IV) 17. (p. 231. B. vol. 2. p. 168. H.) In the year called the 23d of Dionysius, the 27th of Hydron, the planet Mercury was three diameters of the moon to the northwards of the bright star in the tail of Capricorn. The year was the 486th of Nabonassar; Choeac 17-18, in the morning. ☉♈ $-261^y - 41.05^d$.

486, Phamenoth (VII) (p. 232. B. vol. 2. p. 169. H.) In the 23d year of Dionysius, the 4th of Tauron, in the evening, Mercury was at the distance of 3 moons from the line drawn through the bull's horns, or in ♉ 23° 2′; the year being the 486th of Nabonassar: the mean sun being in ♈ 29½°: the time was "Phamenoth, the evening of the 30th to the 1st:" this must have been the evening between the 30th of Mechir and the 1st of Phamenoth, in order that the sun's longitude may have been less than 30°: or ☉♈ $-261^y + 31.6^d$.

486, Payni (X) 30. (p. 232. B. vol. 2. p. 170. H.) In the 24th of Dionysius, the 28th of Leonton, in the evening; Mercury preceded Spica, according to Hipparchus's reckoning, a little more than 3°; being in 19½° of ♍. ☉♈ $-261^y + 151.6^d$.

491, Pharmuthi (VIII) 5. (p. 232. B. vol. 2. p. 169. H.) In the 28th year of Dionysius, the 7th of Didymon in the evening, Mercury was in a line with the heads of the Twins, 1⅔ moons to the south of the southernmost, or in ♊ 29° 20′. ☉♈ $-256^y + 65.39$.

504, Thoth (I) 27. (p. 232. B. vol. 2. p. 171. H.) In the 67th year according to the Chaldeans, on the 5th of Apellaeus, Mercury was in ♏ 2° 20′: this was the 27-8 of Thoth, 504 N. towards the morning. ☉♈ $-243^y - 125.55^d$.

Hence the first Chaldean year must have been the 438th of Nabonassar. Apellaeus is the second of the Macedonian months; and if Dius the 1st had 30 days, this Macedonian year must have begun about 159½ days before the vernal equinox, if 29, 158½.

507, Epiphi (XI) 17. (p. 261. B. vol. 2. p. 263. H.) In the 47th year of Dionysius; the 10th of Parthenon, Jupiter eclipsed the star called the southern ass, near the nebula of Cancer, in ♋ 11° 20′, the 17-18th of Epiphi in the morning, the 83d year after the death of Alexander. ☉♈ $-240^y + 163.82^d$.

512, Thoth (I) 9. (p. 232. B. vol. 2. p. 170. H.) In the 75th

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year according to the Chaldeans the 14th of Dius, Mercury was above the southern star of Libra, half a cubit, or in ♎ 14° 6′: this was the 512th of Nabonassar, the 9-10th of Thoth in the morning. ☉♈ − 235y − 145.39d.

The first of Dius and of the Macedonian year, was here consequently about 158½ days before the equinox: so that if Dius had 29 days, there were exactly 8 correct years from the beginning of the 67th to that of the 75th Chaldean year. See 504.

519, Tybi (V.) 14. (p. 269. B. vol. 2. p. 288. H.) In the 82d year of the Chaldeans, the 5th of Xanthicus, in the evening, Saturn was below the southern shoulder of the Virgin 4 digits: this was in the evening of the "12 Tybi, the 519th of Nabonassar;" but, for 12, Ideler and Halma read 14.

☉♈−228y−22.38d.

If the 5 Macedonian months preceding Xanthicus contained 147 days, the 5th of this month was the 152d of the year, which must have begun 173½d before the vernal equinox, instead of 158½; that is, 15 days earlier than in the year 512.

547, Mesore (XII) 16. (p. 106. B. p. 279. H.) An eclipse of the moon, quoted by Hipparchus, was observed at Alexandria, in the 54th year of the second Calippic period, on the 16th of the Egyptian month Mesore: the middle was 5⅓ hours before midnight, 546y 345d. 6½h from the epoch. ☉♈ − 200y + 182.74d.

The 51st year of this Calippic period *began* therefore about the 9th Egyptian month of 544 N., that is, soon after the summer solstice of that year; which was 76 years later than 468, the date of the solstice observed by Hipparchus, at the end of the 50th Calippic year of the first period: the beginning of which was 50 years earlier, or in 418 of Nabonassar.

548, Mechir (VI.) 9. (p. 106. B. p. 280. H.) In the 55th year of the same period, the middle of a total lunar eclipse was 547y 158d 13⅓h after the epoch, or ☉♈ − 199y − 4.24d.

The interval from the last eclipse, according to Hipparchus, was 178d 6h, according to Ptolemy, 178d 6h 50m.

548, Mesore (XII) 5, (p. 106. B. p. 281. H.) A second total eclipse of the moon occurred in the same 55th year of the second Calippic period, on the 5th of Mesore: the middle, according to Hipparchus, was at 14⅓, simply; or accurately, reckoning by mean time, at 13¾h, giving 547y 334d 13¾h from the epoch, and an interval of 176d ⅘h from the time of the preceding eclipse, that is, ☉♈ − 199y + 171.78d.

There can be no ambiguity respecting the succession of the first and third of these eclipses, which happened at the distance of a lunar year from each other, and which must naturally have

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happened in two successive years of any system of chronology. But it is much less intelligible, that the second eclipse should be referred to the latter rather than the former of the Calippic years, which must be supposed to have begun about 94^d after the vernal equinox of —199, while the eclipse happened a few days before the equinox; though certainly in the same Egyptian year. There cannot well be an error in the manuscripts; because the years are expressly called the same.

552, Mechir (VI) 18. The date of the Pillar of Rosetta. The 476th of Nabonassar being the 13th of Philadelphus, the 38th, or last of this prince must have been the 501st N. the 25th of Evergetes the 526th; the 17th of Philopator the 543d, and the 9th of Epiphanes the 552d. ☉♈ $-195^y+4.2^d$.

The same inscription bears the date of the 4th of Xanthicus, which was probably the 151st of the Macedonian year, and the beginning of this year was about 154 days before the vernal equinox: while in 512, that is 40 years before, it had begun 158 days before the equinox: the difference amounting but to 4 days, which is probably less than the error that would attend any other date that could be substituted: and Mr. St. Martin's attempt to prove, that the year of the young king began with the 15th of his father, appears to be completely unsuccessful. Dr. Young seems to have been too hasty in allowing the opinion of this ingenious antiquary to influence his dates of the reigns of the Ptolemies in this particular. (Discoveries, p.143.)

The perfect agreement of the Macedonian year, at least as observed by the "Chaldeans," in 504 and 512 of Nabonassar, with the true tropical year, leads us at once to suppose, that they must have retained the very ancient mode of intercalation which consisted in inserting three months in each "octaëterid:" and the example of the year 519, when the Macedonian year began 15 days earlier than it must have done in 520, shews that there must have been an intercalary month at the end of 519, though there seem to be but 26 days left for it. The precise order of the intercalations has not been fully explained in any good authority: and it is certain that it must have varied greatly among the different nations of the Greeks: for we have the direct testimony of several historians, and particularly of a letter of Philip, quoted by Demosthenes, to prove that the Macedonian names of the months were employed with considerable variations in Macedon and at Corinth. But the best account of these periods is found in Geminus, the author of the Introduction to the Phenomena. (Halma's Ptolemy, vol. 3, p. 44.)

"The first chronological period employed by the ancients was the Octaëterid, which contains 99 months, 3 of them in-

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tercalary, and 2924 days. The solar year containing $365\frac{1}{4}$ days, and the lunar 354, they observed, that the lunar year was $11\frac{1}{4}$ days shorter than the solar, and they inquired what multiple of this time would give them complete months. Now, 8 times $11\frac{1}{4}$ are 90 days, or 3 months: and these months they introduced in the 3d, 5th, and 8th years of each cycle: leaving two years unaltered between two of the pairs of intercalations, and one between the other pair: and since two lunar months make 59 days, they reckoned the months alternately of 29 and 30 days, or deficient and complete, as they were called.

"The octaëterid, thus constituted, agreed sufficiently well with the course of the sun, but not so accurately with that of the moon: for the true month consists of $\frac{1}{33}$ of a day more than $29\frac{1}{2}$, so that the 99 true months made $2923\frac{1}{2}$ days: while the 8 solar years gave only 2922 days: and the lunar period was a day and a half greater than the solar, two octaëterids wanting 3 days of the corresponding 198 months: of course in 20 octaëterids, the difference amounted to a month; and it was necessary to omit an intercalary month once in 160 years, and to make only 29 instead of 30 intercalations in that period.

"These proportions, however, are still in want of further correction, and instead of omitting an intercalation in 20 octaëterids, it is more accurate to omit one in 19: and instead of 3×19 or 57 intercalations in this time, to make only 56, that is 7 in each period of 19 years.

"On this last correction the periods of [Meton] Euctemon, Philippus, and Calippus, were founded. They first took the solar year as containing $365\frac{5}{19}$ days, making 6940 days in 19 years, and of the 235 months in this period they made 125 complete and 110 defective; the complete and defective months not being always alternate: and 110 being [about] the 63d part of 6940, they left out one day of a complete month every 63d day of the period. Calippus afterwards found that the year, thus measured, was $\frac{1}{76}$ of a day too short: he therefore established a period of 76 years, in which he corrected the error by dividing it into 940 months, of which 28 are intercalary; the whole containing 27759 days."

This arrangement of Calippus was admirably adapted for preserving the order of the true lunar months: but it must have deviated very considerably from that of the solar years: and we have no positive evidence of the manner in which the seven intercalary months were distributed among the 19 years into which each quarter of the period was divided.

The same period of nineteen years is still of considerable use in modern chronology: for in the present century, if we divide the date of the Christian year by 19, multiply the remainder by 11, and divide by 30; the last remainder will be the EPACT,

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or the moon's supposed age on the first of January; and the former remainder, increased by 1, will give the GOLDEN NUMBER. Thus in 1828, the golden number is 5, and the epact 14.

But to return to the Pillar of Rosetta; it is perfectly true, that the agreement of the two dates would be more satisfactory, according to the evidence of 504 and 502 N. if we supposed the time 3 years earlier, as Mr. St. Martin has done. For at those dates the Macedonian year began 158 days before the vernal equinox; and if it had done the same in 552, as we should expect, the date would have been the 8th of Xanthicus: in 551, since an intercalation must have intervened, as in 519, the date of the same Egyptian day would have been 19 days later, or the 27th; the year before, the 16th; and in 549, probably about the 5th of Xanthicus, instead of the 4th. But this analogy is by no means sufficient to make it probable, that the real 6th year of Epiphanes should have been called the 9th: and we may oppose to it the direct inference from the later date of the year 519, in which the 5th of Xanthicus was 22 days before the vernal equinox, and according to the regular observance of the octaëterid, this must probably have happened again in the year 551: and to the 5th of Xanthicus in 552 there must have been $354 + 29 = 383$ days, or 18 days above the solar year: which deducted from 22, leaves 4 days for the date of the 5th of Xanthicus before the vernal equinox, or 5 days for that of the 4th: while the Egyptian date of Ptolemy gives us $4\frac{1}{4}$: and no greater perfection can reasonably be descried in such a coincidence: indeed we have only to suppose the intercalary month to have contained 30 days, which is perfectly admissible, to have the 4th of Xanthicus, instead of the 5th, for the synonym of the 18th of Mechir.

The knowledge, which we have thus acquired of the Macedonian calendar, will enable us to form a satisfactory estimation at least, if not a certain demonstration of the date of the death of Alexander, which was clearly in the Egyptian year 424 of Nabonassar, and which, as Plutarch informs us, on the authority of the official journal of his illness, happened on the 28th of the month Daesius, which was the eighth month of the year, and the day the 234th. Now, if the Macedonian year began 158 days before the vernal equinox of 504, it probably did the same in 424, and the former year beginning about $\overset{\odot}{\Upsilon} - 243^{y} - 158^{d}$, the latter must have begun about $\overset{\odot}{\Upsilon} - 323^{y} - 158^{d}$, and the day in question must have been about $\overset{\odot}{\Upsilon} - 323^{y} + 76^{d}$: that is, in the common language of chronologers, about the 9th of June, 324 B. C. This date agrees sufficiently well with the season of the year assigned by an ancient author, quoted by Mr. St. Martin, to the death of Diogenes, which is supposed to have happened on the same day with that of Alex-

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ander: but even if it was on the 22d of June, as Mr. St. Martin supposes, it could scarcely have been on his road to the Olympic games, that Diogenes died. The intercalary month this ingenious critic thinks, the " Dioscorus" mentioned in the Maccabees. Plutarch tells us, that Alexander was born on the 6th of the month Loüs, which was the tenth of the Macedonian year; and this date agrees well enough with the story of Philip's receiving an account of a victory at the Olympic games, and of the birth of his son on the same day.

574, Phamenoth (VII) 27, (p. 142. B. p. 389, H.) In the 7th year of Philometor, which is the 574th of Nabonassar, the 27-8th of Phamenoth, the moon was eclipsed to the extent of 7 digits on the northern limb; the interval from the epoch to the middle of the eclipse being 573^y 206^d 14^h mean time in Alexandria. ☉♈ $-173^y+37.51^d$.

The last year of Philopator having been 543 N. that of Epiphanes 567 N. the 7th of Philometor must have been 574 N.: so that the lengths of the reigns of these kings assigned by the chronologers is fully confirmed by the authority of Ptolemy, as well as by that of the manuscripts of the Cholchytae still existing at Turin.

586, Mesore (XII) 30. (p. 60. B. p. 156, H.) Hipparchus says that in the 17th year of the third Calippic period, the autumnal equinox was observed the 30th of Mesore, about sunset. ☉♈ $-161^y+187.0^d$.

The interval 187 days agrees with the direct observation of Ptolemy (p. 72. B.)

The autumnal equinox of the first year of this period must have been in 570 N. We have already seen that Mesore 547 was in the 54th year of the second period, and Mesore 570 would have been in the 77th of that period, or the 1st of the succeeding.

589, Epagomenae (XIII) 1. (p. 60. B.) Three years afterwards, that is, in the year 20, the equinox was at on the 1st of the Epagomenae in the morning ☉♈ $-158^y+186.9^d$.

590, Epagomenae (XIII) 1. In the 21st year the equinox was observed at the 6th hour. ☉♈ $-157^y+186.9^d$.

601, Epagomenae (XIII) 3-4; after 11 years, in the 32d year of the period, the autumnal equinox was observed at midnight, the 178th year after Alexander, 285 years before the 9th of Athyr in 463 after Alexander: the observation was made with great care. ☉♈ $-146^y+186.87^d$.

602, Mechir (VI) 27. (p. 62. B. p. 154. H.) Hipparchus says, that the vernal equinox was very accurately observed in the

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32d year of the third period of Calippus, on the 27th of Mechir in the morning, about the 5th hour: the year being the 178th after the death of Alexander, which is the 602d of Nabonassar. ☉♈ $-145^{y}+.05^{d}$.

Ptolemy says that this observation was 285 years before that of the 7 Pachon, 463 after Alexander: this must therefore have been subsequent to the autumnal equinox last mentioned, which he refers to the end of the same Egyptian year after the death of Alexander; and there must either have been a mistake in some of the numbers, or Ptolemy must have reckoned the year after the death of Alexander from the summer. The error has been already corrected by making the dates of the autumnal equinoxes from 586 to 601, a year earlier than would be inferred from the year of Alexander: and it has been found that the date of the Calippic period becomes correct 686 N. We find also that both these equinoxes happened 285 Egyptian years and 70 days before those of Athyr (IV), and Pachon (IX) of the 3rd of Antonine, and this could only have been true, if one was at the end of 601, the other in the middle of 602.

602, (p. 61. B.) Hipparchus found the longitude of Spica 186° 30′.*

602, Epagomenae (XIII) 4. (p. 153. H.) After a year the autumnal equinox of Calippus's 33d year was on the 4th of the Epagomenae in the morning. ☉♈ $-145^{y}+186.88^{d}$.

603, Mechir (VI.) (p. 60. B.) The vernal equinox, according to Hipparchus, was observed very nearly at intervals of 365¼ days. ☉♈ -144.00^{y}.
604, Mechir (VI.) ☉♈ -143.00^{y}.
605, Mechir (VI.) ☉♈ -142.00^{y}.

605, Epagomenae (XIII) 4. (p. 60. B. p. 153. H.) The autumnal equinox was observed in the evening. ☉♈ $-142^{y}+186.9^{d}$.

606, Mechir (VI). Vernal equinox. ☉♈ -141.00^{y}.

607, Tybi (V) 2. (p. 142. B. p. 390. H.) In the 37th year of the third Calippic period, the middle of a lunar eclipse observed at Rhodes, was 606^{y} 121^{d} 10^{h} 10^{m} after the epoch, both in apparent and in correct time, or ☉♈ $-140^{y}-55.65^{d}$.

607, Mechir (VI). (p. 60. B.) Vernal equinox. ☉♈ -140.00^{y}.

613, Mechir (VI). (p. 60. B. p. 156. H.) In the 43d year of the third Calippic period, the observation of the vernal equinox was made at midnight of the 29-30th of Mechir, agreeing with the time of the observation made 11 years before. ☉♈ $-134^{y}+0.03^{d}$.

614..620, (p. 60.) The agreement of the equinoxes with the

...ptian year of Nabonassar.

regular interval of about 365¼ days was observed in each of these years by Hipparchus, about

☉♈ -133.0^y to ☉♈ -127.0^y.

620, Phamenoth (VII) 1. (p. 60, 63. B. p. 163. H.) The equinox was observed about sunset, that is 1¾d. later than the observation made 7 years before, in the 43d year of the period.

☉♈ -127.00^y.

620, (p. 167. B. vol. 2. p. 12, 13. H.) In the 50th year of the third Calippic period, the longitude of the Lion's heart, according to Hipparchus, was 29° 50′. Ptolemy made it 2° 40′ more in the 2d year of Antonine.

620, Epiphi (XI) 16. (p. 111. B. p. 295. H.) Hipparchus found at the interval from the epoch of 619^y 314^d 17^h 50^m. apparently, but accurately 45^m, the distance of the sun from the moon 86° 15′. ☉♈ $-127^y+134.51^d$.

621, Pharmuthi (VIII) 11. (p. 112. B. p. 299. H.) Hipparchus relates, that he observed at Rhodes the true distance of the sun and moon, 313° 42′ very nearly, 620^y 219^d $18\frac{1}{3}^h$, apparently, but correctly 18^h, after the epoch ☉♈ $-126^y+39.28^d$.

621, Payni (X) 17. (p. 114. B. p. 304. H.) In the same year, 197 after the death of Alexander, Hipparchus observed in Rhodes the moon's longitude 20° of ♌, both apparently and truly, for she had then no parallax in longitude: the time was 620^y 286^d 4^h. apparently, but correctly 3⅔h. after the epoch.

☉♈ $-126^y+105.66^d$.

719. The first year of Augustus, (p. 79. B. p. 204. H.) From the 1 Augustus to the 17 Adrian, the interval is 161 Egyptian years: from the epoch to the 17 Adrian 879: this year was therefore the 880th of Nabonassar, and the first of Augustus the 719th.

723. Hence the 5th of Augustus was the 723 of Nabonassar. It was in this year, as we are informed by the fragment of the emperor Heraclius, published in Dodwell's Dissertationes Cyprianicae, 1684, (p. 111.) that the Greeks of Alexandria adopted the Julian system of intercalation: and "the number of days added is found by dividing the number of years elapsed from the 5th of Augustus, and neglecting the remainder." This year began with the 28th, or rather the 29th of August, which was the first of Thoth: and in the August of the year *preceding* each bissextile, the Alexandrians reckoned 6 Epagomenae, instead of 5. In Halma's Ptolemy, vol. 3, p. 9. there is a note of Logothetes, from a manuscript in the king's library at Paris, which tells us that the tetraëterids of the Alexandrian year are reckoned from the beginning of the 6th year of Augus-

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tus: the bissextile having been introduced at the time of the taking of Alexandria by that emperor. See 1112.

The 1 Thoth 723 was ☉♈ $-24^{y}-205.2^{d}$.

$=$ ☉♈ $-25^{y}+160.0^{d}$.

This is about 27 days before the autumnal equinox. It has been generally admitted that the 1 Thoth of this year was the 29th of August. The words of Heraclius are, "the Alexandrians call the first month Thoth, which is September, comprehending three days of August:" and the 29th would give but two days of August, and would make the autumnal equinox the 25th or 26th of September. The calendar of the stars attributed to Ptolemy (Halma, v. 3, p. 21.), has, indeed, an interpolation of a Roman, after the 1 Thoth, "according to *our* date, the 29th of August:" and the autumnal equinox is marked on the 28 Thoth: the vernal the 26th of Phamenoth; the summer solstice the 1 Epiphi; the winter the 26th Choeac: agreeing sufficiently well with the reduction from Ptolemy; for 205 days from the 1 Thoth give us the 26th of Phamenoth. Logothetes, and the other later chronological fragments published by Halma, *agree* in making the 29th August the 1st of Thoth.

840, Tybi (V.) 2. (p. 170, B. vol. 2, p. 22, H.) Agrippa relates that he observed in Bithynia, in the 12th year of Domitian, the 7th of "their month Metroüs," an occultation of the southern following part of the Pleiades; whence the true place of the moon is made 3° 7′ ♉, the date being the 840th year of Nabonassar, 2 Tybi, $6\frac{2}{3}^{h}$. apparent time, $6\frac{1}{4}^{h}$. correct time. ☉♈ $+93^{y}-112.23^{d}$.

The 1st of Domitian was therefore 829 N.

845, Mechir (VI.) 15, (p. 170, B. vol. 2, p. 25, H.) The first year of Trajan, the 15-16 Mechir, the moon occulted Spica 5 equinoctial hours after midnight, or $6\frac{1}{2}$ hours in Alexandria; that is, about $6\frac{1}{4}^{h}$. mean time, ☉♈ $+98^{y}-69.97^{d}$.

845, Mechir (VI.) 18, (p. 171, B. vol. 2, p. 27, H.) The first year of Trajan, Mechir 18-19, 6^{h}. 10^{m}. after midnight at Rome, 7^{h}. 30^{m}. at Alexandria, Menelaus observed the southern horn of the moon in a line with the middle and the southernmost star in the forehead of the scorpion, her centre being as much behind the middle star as this was behind the southernmost. ☉♈ $+98^{y}-66.92^{d}$

872, Pachon (IX.) 17, (p. 102, B. p. 267, 268, H.) The "8th" year of Adrian, the 17-18 of Pachon, the moon was eclipsed $\frac{1}{6}$ of her diameter on the southern limb: the interval was 871^{y}. 256^{d}. 8^{h}. 24^{m}. apparently, or correctly 5^{m}.

☉♈ $+125^{y}+15.17^{d}$.

Halma says very truly 9 Adrian. See 719.

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874, Pachon (IX.) 17, (p. 263, B. vol. 2, p. 268, H.) The 11th year of Adrian, Pachon 7-8, in the evening, the opposition of Saturn was observed by Ptolemy in ♎ 1° 13′.
☉♈ $+127^{y}+5.50^{d}$.

875, Athyr (III.) 21. (p. 239, B. vol. 2, p. 195, H.) Theon observed, in the 12th of Adrian, 21-22 Athyr, in the morning, the greatest elongation of Venus, when her longitude was ♍ 0° 20′. ☉♈ $+128^{y}+161.30^{d}$.

876, Epiphi (XI.) 2, (p. 239, 240, B. vol. 2, p. 196, H.) According to Theon, in the 13th of Adrian, the 2-3 of Epiphi, Venus was in longitude 10° 36′, S. lat. 1° 30′.
☉♈ $-129^{y}+59.26^{d}$.

877, Mesore (XII.) 18, (p. 234, B. vol. 2, p. 176, H.) Theon observed, the 18th of Mesore of the 14th of Adrian, in the evening, the greatest elongation of Mercury in longitude 120° 20′.
☉♈ $+130^{y}+104.87^{d}$.

878, Tybi (V.) 26, (p. 245, B. vol. 2, p. 214, H.) Ptolemy observed in the 15th of Adrian, the 26-27 Tybi, one hour after midnight, the opposition of Mars in ♊ 21°.
☉♈ $+131^{y}-97.57^{d}$.

879, Phamenoth (VII.) 16, (p. 231, B. vol. 2, p. 166, H.) Ptolemy observed, in the 16th of Adrian, the 16-17th of Phamenoth, the greatest elongation of Mercury, in longitude 1° ♓; its distance from the sun being 21¼°. ☉♈ $+132^{y}-47.46^{d}$.

879, Pharmuthi (VIII.) 21, (p. 239, B. vol. 2, p. 195, H.) In the 16th of Adrian, the 21-22 Pharmuthi, Theon observed the greatest elongation of Venus, in longitude 31° 30′.
☉♈ $+132^{y}-12.46^{d}$.

880. Athyr (III.) 7, (p. 62, B. p. 204, H.) Ptolemy observed the autumnal equinox in the 17th year of Adrian, on the 7th of Athyr, about two equinoctial hours after noon: the interval from the epoch being $879^{y}.\ 66^{d}.\ 2^{h}$. ☉♈ $+132^{y}+188.12^{d}$.
= ☉♈ $+133^{y}-177.12^{d}$.

880, Payni (X.) 20, (p. 254, H.) Ptolemy observed at Alexandria a total eclipse of the moon, the 17th of Adrian, Payni 20-21; the middle $1\frac{1}{4}^{h}$. before midnight. ☉♈ $+133^{y}+46.24^{d}$.

880, Epiphi (XI.) 1, (vol. 2, p. 243, H.) An opposition of Jupiter was observed in the 17th of Adrian; one hour before midnight, in ♏ 23° 11′ ☉♈ $+133^{y}+57.25^{d}$.

880, Epiphi (XI.) 18, (p. 263, B. vol. 2, p. 268, H.) Ptolemy observed an opposition of Saturn, the 17th of Adrian, Epiphi 18, 4 hours after noon, in ♐ 9° 40′. ☉♈ $+133^{y}+73.95^{d}$.

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881, Epiphi (XI.) 18, (vol. 2, p. 167, H.) Ptolemy observed, in the 18th of Adrian, 18-19 Epiphi, in the morning, the planet Mercury at his greatest elongation, in 18¾° ♉, near the Hyades, the distance to the east of the mean sun being 21¼°. ☉ $+134^y+74.26^d$.

882, Athyr (III.) 14, (vol. 2, p. 172, H.) Ptolemy observed, in the 19th of Adrian, the 14-15 Athyr, Mercury at his greatest elongation east, by comparison with Regulus, in 20° 12′ ♍, at the distance of 20° 3′ from the mean sun. ☉ $+135^y-170.18^d$.

882, Choeac (IV.) 2, (p. 255, H.) Ptolemy observed an eclipse of the moon, in the 19th of Adrian, the 2-3 Choeac, of 10 digits on the northern limb, the middle an hour before midnight. ☉ $+135^y-152.23^d$.

882, Pharmuthi (VIII.) 6, (vol. 2. p. 214, H.) Ptolemy observed an opposition of Mars, the 6-7 Pharmuthi, 3 hours before midnight, in ♌ 28° 50′. ☉ $+135^y-28.31^d$.

882, Pachon (IX.) 19, (vol. 2, p. 173, H.) Ptolemy observed Mercury at his greatest elongation, on the 19th of Pachon, in ♉ 4° 20′; by comparison with the Hyades: the distance from the mean sun being 23¼°. ☉ $+135^y+14.81^d$.

883, Athyr (III.) 13, (p. 332, H.) Ptolemy observed the moon's transit in the 20th of Adrian, the 13th Athyr, just before sunset, 5h. 50m. after noon: the altitude of her centre being 50° 55′; whence the parallax is found 50′ 55″: the interval from the epoch was apparently 882y. 72d. 5h. 50m.; but correctly 5h. 20m. ☉ $+136^y-171.69^d$.

In this computation the latitude of Alexandria is made 30° 58′ instead of 31° 12′: and it is inconceivable how an error of such magnitude can have been committed by astronomers so numerous and so accurate as those of the school of Alexandria.

883, Pharmuthi (VIII.) 19, (p. 255, H.) Ptolemy observed a lunar eclipse the 20th of Adrian; the middle at four hours after midnight of the 19-20 Pharmuthi: the magnitude 6 digits, on the northern limb. ☉ $+136^y-15.26^d$.

883, Mesore (XII.) 24, (p. 270, B. vol. 2, p. 268, H.) Ptolemy observed an opposition of Saturn, the 20th of Adrian, 24 Mesore, at noon, in ♑ 14° 14′. ☉ $+136^y+109.07^d$.

884, Paophi (II.) 13, (vol. 2, p. 244, H.) Ptolemy observed, in the 21st of Adrian, an opposition of Jupiter, the 13-14 Paophi, 2 hours before midnight, in 7° 54′ ♓. ☉ $+136^y+163.49^d$.

884, Tybi (V.) 2, (vol. 2, p. 197, H.) Ptolemy observed, in the 21st of Adrian, the 2-3 Tybi, the greatest elongation of Venus,

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in 12° 50′ ♑, by comparison with the horns of the constellation Capricorn; the distance from the mean place being 47° 20.
☉♈ + 137y − 122.67d.

884, Mechir (VI.) 9, (p. 239, B. vol. 2, p. 195, H.) Ptolemy observed, the 21st of Adrian, the 9-10 Mechir, the greatest elongation of Venus, in 19° 36′ ♒, at the distance of 47° 32′ from the mean sun. ☉♈ + 137y − 85.67d.

885, In the beginning of the reign of Antonine, the longitude of Sirius was ♊ 17° 40′ (vol. 2, p. 96, H.); which agrees with the general catalogue, (p. 73).
The 1 Thoth of this year was ☉♈ + 137y + 120.83d.

885, Athyr (III.) 20, (vol. 2, p. 243, H.) Ptolemy observed an opposition of Jupiter in the first year of Antonine, the 20-21 Athyr, 5 hours after midnight, in longitude 14° 23′: 1 year, 37d. 7h. after the opposition in the 21st of Adrian.
☉♈ + 138y − 164.71d.

885, Epiphi (XI.) 20, (vol. 2, p. 167, H.) Ptolemy observed, in the first year of Antonine, the 20-21 Epiphi, the greatest elongation of Mercury, in longitude 7° ♋, by comparison with Regulus: the distance from the mean place being 26¼°.
☉♈ + 138y + 75.09d.

886, Tybi (V.) 29, (vol. 2, p. 201, H.) Ptolemy observed, in the second of Antonine, 29-30 Tybi, the greatest eastern elongation of Mercury, 4½ hours after midnight, in longitude ♏ 6½°, by comparison with Spica. ☉♈ + 139y − 95.98d.

886, Mechir (VI.) 6, (vol. 2, p. 284, H.) Ptolemy observed, in the second year of Antonine, Mechir 6-7, 4 hours before midnight, the longitude of Saturn, by comparison with the Hyades, ♒ 9° 4′, being half a degree distant from the visible place of the moon at Alexandria, which was then 8° 34′.
☉♈ + 139y − 89.32d.

886, Phamenoth (VII.) 25. (p. 293. H.) Ptolemy observed, the second year of Antonine, the distance of the moon from the sun 5¼ hours before noon: the moon was in 9½° ♏, without sensible parallax in longitude: the interval is 885 years, 203 days, 18¼ hours; both apparently and correctly.
☉♈ + 139y − 40.9d.

Halma has $18\frac{1}{2}\frac{2}{3}$° instead of $18\frac{1}{2}\frac{1}{3}$° for the sun's apparent place, which was ♒ 18° 50′.

886, Pharmuthi (VIII.) 9. (vol. 2. p. 11. H.) Ptolemy observed in the 2d of Antonine, the 9 Pharmuthi, near sunset, the last degree of ♉ being on the meridian, that is, 5½ hours after the noon of the 9th, the apparent distance of the moon from the sun 92⅛°: and half an hour after the sun had set, the moon's distance from Regulus in longitude was 57° 10′. The sun's

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true place at first was in 3° 3′ ♓, whence the moon's was 5° 10′ ♊: in half an hour the moon must have advanced about 15′, and allowing for the parallax, the true place of Regulus is found in ♌ 2° 10′. This was about 265 years after Hipparchus. The time at noon . ☉♈ + $139^y - 26.66^d$.

886, Epiphi (XI.) 2. (Vol. 2. p. 183. H.) Ptolemy observed the 2d of Antonine, which was the 886th of Nabonassar, the 2-3 Epiphi, the planet Mercury before its greatest western elongation, at 4½ hours before midnight: compared with Regulus by means of the astrolabe, he was found in ♊ 17½°, and was 1½° behind the moon's centre. . ☉♈ + $139^y + 56.65^d$.

886, Epiphi (XI.) 12. (Vol. 2. p. 214. H.) Ptolemy observed an opposition of Mars in the 2d of Antonine, the 12-13 of Epiphi, 2 hours before midnight in ♐ 2° 34′. ☉♈ + $139^y + 66.75^d$.

886, Epiphi (XI.) 15, (Vol. 2. p. 233. H.) Ptolemy observed a third opposition of Mars, 3 hours after the midnight of 15-16 Epiphi, in the second year of Antonine: in longitude 1° 36′ ♐, and 1° 36′ before the moon's centre. ☉♈ + $139^y + 69.96^d$.

886, Mesore (XII.) 23, (Vol. 2, p. 177, H.) In the second year of Antonine, the greatest elongation of Mercury was observed by Ptolemy, in longitude ♊ 20° 5′, by comparison with the Hyades; the distance from the mean sun being 20° 15′; in the morning of the 24th of Mesore. ☉♈ + $139^y + 108.04^d$.

887, Athyr (III.) 9, (p. 161, H.) Ptolemy observed the autumnal equinox, "with great care," on the 9th of Athyr, about an hour after sunrise, in the third year of Antonine, which was the 463rd after the death of Alexander. ☉♈ + $139^y + 188.14^d$.

The observation was probably influenced by the computation from those of Hipparchus, assuming the year too long.

887, Pharmuthi (VIII.) 4, (Vol. 2, p. 199, H.) Ptolemy observed the greatest elongation of Venus in the third year of Antonine, the night of the 4-5 Pharmuthi, in longitude 13° 50′ ♈, by comparison with the Hyades: the distance from the sun 48° 20′. ☉♈ + $140^y - 31.40^d$.

887, Mesore (XII.) 11, (p. 162, H.) Ptolemy found the summer solstice, in the 463rd year after the death of Alexander, the 11-12 Mesore, about two hours after midnight. See Athyr.
☉♈ + $140^y + 95.68^d$.

[888?] Thoth (I.) 11, (Vol. 2, p. 194, H.) Ptolemy says that he observed, in the "14th" of Antonine, the greatest elongation of Venus, in ♊ 18½°; the distance 47¼; on the 11-12th of Thoth. But we ought probably to read 4 for 14, the I being the ascript of the article, and not a numeral: the date must be later than the 16th of Adrian. ☉♈ + $140^y + 130.6^d$.

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888, Phamenoth (VII.) 18, (Vol. 2. p. 167. II.) The 4th of Antonine, the 18-19 Phamenoth, Ptolemy observed the greatest elongation of Mercury in longitude $13\frac{1}{2}^{\circ}$ ♑ : the distance from the mean place of the sun $26\frac{1}{2}^{\circ}$. ☉ (♈) $+141^y-47.64^d$.

888, Pachon (XI.) 7. (p. 161. II.) Ptolemy found, in the 463d year after the death of Alexander, the vernal equinox on the 7th of Pachon, one hour after noon. See 887. ☉ (♈) $+141^y+0.96^d$.

1112, Phamenoth (VII.) 6, (Theon, p. 284, 277, 281. B.) An eclipse of the moon was observed by Theon the commentator, $6\frac{1}{10}$ hour after noon of the 6 Phamenoth, or $7\frac{1}{10}$ hours apparent time: the moon being in ♉ 28° 15′ 10″. ☉ (♈) $+365^y-113.9^d$.

This was "the 81st year of Diocletian, according to the Alexandrians in the month of Athyr, but according to the Egyptians, the 81st year in the month of Phamenoth." "The conjunction which took place in the month Thoth, was on the 21th, according to the tables, and reckoning back 97 for the difference of the years, we have the 22 Payni of the preceding year for the Alexandrian date, since $24+365-97=389-97=292$." The Alexandrian year having been introduced in 723 of Nabonassar, we have $1112-723=389=4\times97\frac{1}{4}$. And in the same manner the 6 Phamenoth, deducing 97 days, gives the 29th of Athyr, which was the Alexandrian time of the eclipse. The preceding conjunction was, according to the tables, on the 21 Mechir.

It follows that the years of Diocletian are found by deducting 1031 from those of Nabonassar, and that the first of Diocletian was 1032 of Nabonassar. Heraclius says that there were 313 from the 1 Augustus, to the 1 Diocletian, and $719+313=1032$.

We are informed in the same chapter of Theon, (p. 280.) that the "table of cities" gives the longitudes East from the "Fortunate islands;" and we are directed to take out of it the difference of the longitude of a given place from that of Alexandria, in order to find the time of that place.

In Heraclius's example of Alexandrian time for the 77th of Diocletian, the time reckoned from the 5th of Augustus is 385 years, or $4\times96\frac{1}{4}$, and 96 days are deducted. P. 111. See 723.

1223, Athyr (III.) 21, (Halma, Vol. 3. p. 11.) The 192d year of Diocletian, the 21 Athyr, the moon was observed by Thius at Athens to pass over Venus, in 13° ♑, and 48° from the sun. This would be ☉ (♈) $+477^y-246^d$.

But the longitude of Venus being 283°, that of the sun should have been 235°, or 331°, which it could not be 246 days before

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the equinox. The time must therefore have been Alexandrian, that is, 125 days later, or ☉♈ $+ 477^{y} - 121^{d}$.

$=$ ☉♈ $+ 476^{y} + 244^{d}$.

and the sun must have been behind Venus. The other observations of Thius are probably recorded in the same time.

1245, Pachon (IX.) 6, (Halma, Vol. 3. p. 10.) Heliodorus observed, in the 214th year of Diocletian, the 6-7 Pachon, the second hour of the night, Mars in perfect contact with Jupiter. The interval from the epoch was 1244^{y} and either 245.33^{d}. or 375.33^{d}. E. T. ☉♈ $+ 498^{y} - 38.1^{d}$.

or A. T. ☉♈ $+ 498^{y} + 91.9^{d}$.

1250, Mechir (VI.) 27, (Halma, Vol. 3. p. 10.) Heliodorus observed in 219 of Diocletian, an occultation of the planet Saturn by the moon, the 27-8 Mechir, a little after the 4th hour of the night, the middle being about 5 hours after sunset: the emersion was at the middle of the enlightened part of the moon.

Either E. T. ☉♈ $+ 503^{y} - 156.3^{d}$.

or A. T. ☉♈ $+ 503^{y} - 24.3^{d}$.

1256, Thoth (I.) 30, (Halma, Vol. 3. p. 11.) Thius observed the passage of Jupiter 3 digits to the North of Regulus, the 225th of Diocletian. The 133 days of intercalation make this the 163d day of the old Egyptian year, and the equinoctial date ☉♈ $+ 509^{y} - 182.0^{d}$.

1256, Phamenoth (VII.) 15, (Halma, Vol. 3. p. 11.) Thius found that the moon in $16\frac{1}{2}^{\circ}$ ♉ must have occulted the Hyades in the day time: 225 of Diocletian. ☉♈ $+ 509^{y} - 6.2^{d}$.

1256, Payni (X.) 29, (Halma, Vol. 3. p. 11.) Thius observed, that soon after sunset the planet Mars was near to Jupiter 1 digit to the west: in the situation which the tables indicated for the 23d of the same month: the year was the 225th of Diocletian.

☉♈ $+ 510^{y} + 98.3^{d}$.

1257, (Halma, Vol. 3. p. 12.) In 226 after Diocletian, Thius found that Venus was 20 digits before Jupiter . . . . and on the 29th. . .10 digits behind him, in the same latitude: while the ephemerides made the conjunction on the 30th: Bouillaud says, of Mesore

The year began in Alexandrian time ☉♈ $+ 511^{y} - 201^{d}$.

the 30th Mesore, noon, ☉♈ $+ 511^{y} + 158^{d}$.

DATES *from the Catalogue of* OLYMPIADS.

Olympiadic year. | Solstitial date of the beginning.

In Scaliger's edition of Eusebius, there is a Catalogue of the Olympiads, among the Collections

Olympiadic year. | Solstitial date of the beginning.

not translated, which has every appearance of high authenticity: the author was acquainted with the principal astronomical occurrences which are mentioned by Ptolemy, and he has introduced many of them in their proper places, at intervals agreeing with those which are assigned by Ptolemy: he seems to have been a person of correct judgment, and he was a Christian, though too fond of recording fictitious prodigies. There is great reason to suppose that he was no other than Africanus, to whom Scaliger himself attributes the more meagre catalogue of Olympic victors.

Troy taken by the Greeks. See 692. The beginning of Grecian history. About ☉♋ −1016

1. Establishment of the Olympic epoch. See 366 N. ☉♋ −775

6. p. 313, Ol. II. 2. Birth of Romulus and Remus. ☉♋ −770

23. Ol. VI. 3. "Rome founded according to some authors."

25. Ol. VII. 1. Rome founded. ☉♋ −751

This date is confirmed by Dionysius and others. Tarutius, the friend of Varro, as quoted by Plutarch, makes the birth of Romulus the 21 Thoth following the 23 Choeac, in the 1st year of the IId Olympiad, and says, that Rome was founded the 9th Pharmuthi VI. 3: but the Varronian era has not been generally considered as of high authority. Pharmuthi was about the autumnal equinox.

30. Ol. VIII. 2. The beginning of the era of "Nabusar." ☉♋ −746

This Olympic year must have *ended* about ☉♈ $-746^{y}+94^{d}$, that is, at the first midsummer in the reign of Nabonassar: consequently, the first Olympic year *began* 30 years earlier, or ☉♈ $-775^{y}+94^{d}$.

55. p. 314, Ol. XIV. 3. The 1st year of Mardoc Empadus; an eclipse of the moon. See N. 27. ☉♋ −721

The eclipse happened a little before the vernal equinox following this solstice, that is ☉♈ −720.

137. p. 315, Ol. XXV. 1. Thales born. ☉♋ −639

188. p. 316, Ol. XLVII. 4. Vaphres began to reign in Egypt. ☉♋ −588

The article Egypt has 590 B.C.; which, expressed in astronomical language, is −589.

191. Ol. XLVIII. 3. Foundation of the Pythian games. An eclipse of the sun foretold by Thales. ☉♋ −585

Olympiadic year. | Solstitial date of the beginning.

Mr. Baily makes the eclipse mentioned by Herodotus as foretold by Thales, 610, B.C. that is −609. Ph. Tr. 1811. Both these dates might have been in the reign of Alyattes; and *if* the story of Herodotus is true, Mr. Baily's computations are sufficient to prove that the earlier date is correct; and that the eclipse here mentioned was not that of Herodotus. Pliny is the oldest author that has recorded this eclipse, in the reign of Halyattes, as having happened Ol. XLVIII. 4. Mr. Baily makes it 30 Sept. 610, B.C., the sun's declination being 8″: that is, ☉♎ −609.0y; the 167th Olympiadic year.

251. p. 318, Ol. LXIII. 3. Amasis dies, having reigned 55 years. Cambyses conquers Egypt. ☉♋ −525

254. Ol. LXIV. 2. The moon eclipsed in the 7th year of Cambyses. ☉♋ −522

This was 225 N. about 13 days after the solstice of −522; so that the Olympic games *must* have followed very shortly after the solstice.

275. Ol. LXIX. 3. The moon eclipsed, in the 20th of Darius Hystaspis. ☉♋ −501

See 246. N.

344. p. 321, Ol. LXXXVI. 4. Apseudes being Archon, Meton, the son of Pausanias, erected a dial, and made known his cycle of 19 years. ☉♋ −432

The solstice observed by Meton, while Apseudes was Archon, appears from Ptolemy to have been ☉♋ −431, 94 days after the vernal equinox: and the Olympic year having begun soon after the solstice of −431, this observation must have been made at the *end* of the archonship of Apseudes: and we find, in Nabonassar 468, Aristarchus observed the summer solstice at the *end* of a Calippic year.

394. p. 324, Ol. XCIX. 2. Phanostratus being Archon, an eclipse of the moon in Posideon, and again in Scirrophorion. ☉♋ −382

The latter was only 10 days before the solstice of −381, which was near the end of this Olympic year: the former about the winter solstice, or the middle of the year. See N. 366.

395. Ol. XCIX. 3. Menander or Evander being Archon. An eclipse of the moon in Posideon. ☉♋ −381

About midwinter. See N. 367.

Olympiadic year.		Solstitial date of the beginning.
413.	p. 326, Ol. CIV, 1. An eclipse of the sun.	☉♋ −363
415.	Ol. CIV. 3. Tachos, king of Egypt, went through Arabia to meet Artaxerxes, who died this year, after a reign of 43 years.	☉♋ −361
417.	Ol. CV. 1. The reign of Philip began; it lasted 24 years.	☉♋ −359
420.	Ol. CV. 4. Alexander born. Some say a year later.	☉♋ −356
427.	p. 327, Ol. CVII. 3. Nectanebos, king of Egypt, abdicates, and flies into Ethiopia. Artaxerxes conquers the whole of Egypt.	
441.	p. 238, Ol. CXI. 1. Philip is killed, having reigned 24 years.	☉♋ −335
442.	Ol. CXI. 2. Alexander crosses into Asia.	☉♋ −334
446.	p. 329. Ol. CXII. 2. Alexandria founded; an eclipse of the moon; battle of Arbela; beginning of the periods of Calippus of Cyzicum.	☉♋ −330
452.	Ol. CXIII. 4. Alexander marries Statira	☉♋ −324
453	Ol. CXIV. 1. Alexander issues a proclamation before the opening of the Olympic games, for the return of all the Grecian fugitives. He dies in Babylon, having reigned 12 years and 7 months. Diogenes, the cynic, died the same day. See N. 532.	☉♋ −323
	The proclamation was probably issued after the king's actual death.	
[467.	Phil. Tr. 1811. Mr. Baily makes the eclipse of Agathocles mentioned by Diodorus,	☉♋ −309]
602.	p. 333, Ol. CLI. 2. An eclipse of the moon, in the 7th year of Philometor.	☉♋ −174
	Nab. 574. ☉♈ $-173^y+37.51^d$; of course before the solstice −173. The 7th of Philometor began about the autumnal equinox −174.	
692.	p. 335, Ol. CLXXIII. 4. Troy taken by Sylla, 1100 years after its capture by the Greeks.	☉♋ −84
714.	p. 336, Ol. CLXXIX. 2. Cicero consul. Augustus born.	☉♋ −62
729.	p. 337, Ol. CLXXXIII. 1. Battle of Pharsalia. Siege of Alexandria. Epoch of Cæsar's empire, and of the era of the Antiochians.	☉♋ −47

Olympiadic year.		Solstitial date of the beginning.
731.	Ol. CLXXXIII. 3. End of the History of Diodorus. Cæsar corrects the Roman year.	☉♋ −45
735.	Ol. CLXXXIV. 3. Battle of Philippi.	☉♋ −41
737.	Ol. CLXXXV. 1. Herod called king of the Jews.	☉♋ −39
746.	Ol. CLXXXVII. 2. Battle of Actium, "towards the middle of the Olympiad," that is, towards the end of the year.	☉♋ −30
747.	Ol. CLXXXVII. 3. Anthony kills himself.	☉♋ −29
748.	4. Octavius triumphs over Egypt.	☉♋ −28
[illegible]	Ol. CXCIII. 3. Herod dies, and Archelaus succeeds him.	☉♋ −5
[illegible]	p. [illegible] Ol. CXCVIII. 1. Augustus dies.	☉♈ +13
808.	p. 339, Ol. [illegible] 4. Passion of our Saviour Christ.	☉♈ +32
816.	[illegible] CCIV. [illegible] Death of Tiberius.	☉♈ +40
835,	p. 340, [illegible] Nero puts to death Agrippina [illegible] eclipse of the sun, during which the stars [illegible]	☉♈ +59
844.	Ol. [illegible] 4. Nero destroys himself, and is succeeded [illegible] Galba.	☉♈ +68
855.	Ol. CCXIV. 3. Vespasian succeeded by Titus. Herculaneum and Pompeii destroyed by an eruption of Vesuvius.	☉♈ +79
876	p. 341. Ol. CCXIX. 4. End of the Chronicle of Justus of Tiberias, which begins with Moses.	☉♈ +100
892.	Ol. CCXXIII. 4. Trajan dies, after a reign of 19½ years. His bones are deposited in his column.	☉♈ +116
916.	p. 342, Ol. CCXXIX. 4. So far the Olympiads were written by Phlegon of Tralles, a freedman of Adrian, in 16 books.	
979.	p. 343, Ol. CCXLV. 3. Secular games celebrated.	☉♈ +203
992.	Ol. CCXLIX. Heliodorus conquers in the stadium.	☉♈ +216

Date *of the Letter of* Manumission. Hier. 46.

"Constantius Augustus VII.; and Constantius the most Illustrious Cæsar III. Tybi 17; the XIII Indiction.

Olympiadi year.		Solstitial date of the beginning.
1130.	p. 282. Epitome of Chronology. Ol. CCLXXIII. "3:" or, in the margin, 2. Constantius Augustus "IX." and Constans Cæsar III. Indiction XII.	☉ ♋ +354

The numbers are greatly confused, but this seems to be the year intended: the consuls for the next are Arbetion and Lollianus; and in the Catalogue of Idatius, p. 31, these names are preceded by Constantius VII. and Constantius III. The Indictions of Constantine beginning in September, it is very possible that the number 12 in the catalogues belongs to the earlier part of the year, and 13 to the later.

The catalogue in Dodwell's Diss. Cypr. (p. 103), has Constantius VII., Constantius Cæsar III., in the year 354. And the common school books exhibit the same date.

In p. 260, the first year of the Indiction is marked Ol. CLXXXIII. 2; in the margin CLXXXIV. 3: "the 6th year of Cleopatra, the 1st of Julius Cæsar: the Antiochians began their era on the 12th of Artemisius, and the Indiction began the 1st of Gorpiaeus." See 729 N.

In p. 279, the 1st Indiction of Constantine is marked Ol. CCLXXIII. 2; in the margin CCLXXIII. 1. The year 1828 is now called the 1st Indiction; and 1828 − 15 × 125 = − 47; agreeing with the catalogue of Olympiads.

ii. *Principal* Lunar Occultations *of the fixed Stars, calculated for the Royal Observatory at Greenwich. By* Thomas Henderson, *Esq.*

Date.	Names of Stars.	Magnitude.	Immersion and Emersion. Mean Time.	Apparent Difference of Declination.	Point of Moon's Limb.
1828.			H. M. S.	′ ″	°
Oct. 16	β^1 Capricorni	7	Imm. 10 12 50	15 4 N.	10 R.
			Em. 10 51 0	9 16 N.	90 R.
..	β^2 . .	3.4	Imm. 10 17 9	14 29 N.	5 R.
			Em. 10 59 6	8 7 N.	95 R.
22	*o* Piscium	5	Imm. Under	Horizon.	
			Em. 5 34 55	1 37 S.	57 R.

The explanations of the columns are the same as in the preceding Numbers.

[To be continued.]

MISCELLANEOUS INTELLIGENCE.

I. Mechanical Science.

1. *Singular Case of inverted Vision.*—Dr. Goodman relates in the American Journal (of Medical Sciences ?) an instance of a boy, seven years of age, to whom every object appeared inverted. The fact was communicated to Dr. Goodman by the uncle of the boy. "When his father, who was a distinguished artist, began to give him lessons in drawing, he was very much surprised to find that whatever object he attempted to delineate, he uniformly inverted; if ordered to make a drawing of a candle and candlestick set before him, he invariably drew it with the base represented in the air, and the flame downwards. If it was a chair or table he was set to copy, the same result was the consequence; the feet were represented in the air, and the upper part of the object, whatever it might be, was turned to the ground. His father, perplexed at what he considered the perverseness of the boy, threatened, and even did punish him for his supposed folly. When questioned on the subject, the youth stated that he drew the objects exactly as he saw them; and as his drawings were, in other respects, quite accurate, there was no reason to doubt his statement. Whenever the object was inverted previous to his drawing it, the drawing was made to represent it in its proper position, showing that the sensations he received from the eye were exactly correspondent with the inverted pictures formed upon the retina. This condition of his vision was observed to continue for more than a year, when his case gradually ceased to attract attention, which was when he was eight years old; since that time he has imperceptibly acquired the habit of seeing things in their actual position.—*Med. Rep.* vi. 372.

If this case be correctly described, it is unfortunate that the facts were not more closely examined, and their number multiplied. There is nothing extraordinary in the inverted position of the boy's drawing corresponding with the inverted figure of the object formed on the retina; the extraordinary fact is that, of the objects external to the eye, some seemed to the lad in the right position, and others inverted; for from the description it would appear, that the boy saw the upright object to be drawn, and the inverted drawing of it in the *same* position. Query, What would he have done, if he had been told to make a drawing of his drawing? that is, to copy his own drawing. The only way in which the statement can be really true is, that the boy saw objects, erect or inverted, according as they were farther from or nearer to the eye. The inverted drawing should have been carried from the eye until by the side of the object, and then the effect on the lad compared; and if, in the course of that passage, it seemed to change its position so as to become inverted, as compared to the original object,

then the distance at which the change seemed to take place would have been the spot for some interesting experiments.—Ed.

2. *Fissures of Glass.*—These fissures are distinguished by M. Fischer into four kinds. The first are such, that the liquid contained in the broken vessel escapes through them into the air. The second are such as retain the liquid, unless the vessel be immersed in water, or a similar fluid, and then the level of the two portions of fluid tend to approach each other. The third are not permeable unless the fluids on opposite sides have a chemical action on each other; whilst that action continues, the fissure is permeable, but being over, there is no longer a tendency to equality of level. This is also the effect produced by the membrane of the bladder. The fourth kind are so fine that no fluid passes, except in a single case. If a solution of nitrate of silver be put into a glass tube with such a fissure, the latter plunged into water, and then the liquids connected by a voltaic circle, consisting of a platina wire and one of copper or zinc, so that the platina shall be in the solution of silver, and the other wire in the water, in about twenty-four or forty-eight hours crystals of silver will be found on the platina wire, and nitrate of zinc or of copper in the water. If no voltaic circuit be used, no salt of silver will be found in the water even after many days. Salts of lead, tin, and copper will not produce this curious effect.—*Annalen der Phys.* 1827, p. 481.

3. *Change of Crystalline State in a solid Body.*—"It was in the sulphate of magnesia that I first remarked the change, in form, of a solid body, or, more accurately, the change in the position of its atoms, without the assumption of the liquid state. If this salt or the sulphate of zinc be slowly heated in alcohol, and gradually raised to ebullition, the crystals will lose their transparency by degrees, and, when broken, they will be found to be formed of a great number of new crystals, entirely different in their form to those of the salt employed."—Mitscherlich, *Annales de Chimie*, xxxvii. 206.

This is a case of internal motion to be added to those already known of basalt, arsenious acid, barley-sugar, sulphur, &c. &c.

4. *Hardening of Steel by a current of compressed Air.*—From the observation of travellers, that the manufacture of Damascus blades was carried on only during the time when north winds occurred, M. Anozoff made experiments on the hardening of steel instruments by putting them, when heated, into a powerful current of air, instead of quenching them in water. From the experiments already made, he expects ultimate success. He finds that, for very sharp-edged instruments, this method is much better than the ordinary one; that the colder the air and the more rapid its stream, the greater is the effect. The effect varies with the thickness of the mass to be hardened. The method succeeds well with case-hardened goods.—*Bull. Univ.* E. ix. 134.

5. *Tinning of Cast Iron Weights.*—The weights are first to be cleaned in diluted sulphuric acid of specific gravity 1.14 or 1.16, and then put into clean water; they are then to be transferred into an aqueous solution, containing one-eighteenth of sal ammoniac. In the mean time pure fine tin is to be fused, and copper added to it in the proportion of 3 ounces to 100lbs. of tin; it is best to fuse the copper with 6 ounces of tin first, and then add it to the rest. When the tin is sufficiently heated, but not so highly as to prevent its adhering to the iron, the weight is to be plunged into it, and the tin will adhere perfectly. If the weights are to be polished, they should be first turned in the lathe; when thus turned, they are preserved from oxidation, are easily kept clean, and may be used instead of copper weights.—*Industriel.*

6. *Temperature of the Planetary Space.*—According to M. Fourier, the temperature of the space occupied by our planetary system is very nearly 40 octagesimal degrees colder than the temperature of fusing ice.—*Annales de Chimie,* xxxvii. 309.

7. *Mr. Watt's Solar and Lunar Compasses.*—Mr. Watt has lately described, in the philosophical journals, what he calls solar and lunar compasses. The following seems to be the last improvement. Stretch a circular disc of dark-coloured velvet of about four inches diameter upon two very thin slips of light wood, or upon two feathers placed across each other at right angles; render about 25 grains weight of pure filings of steel magnetic by putting them between the folds of a piece of paper and drawing the ends of two magnets about thirty times across them. Rub the filings over the whole face of the velvet disc, they will then sink into the spaces formed by the piles of the silk. Let this be affixed to the end of a very light bar of wood, or to the opaque part of a writing quill four inches long, by a fine needle passed through the disc. Make a small perforation in the wood or quill at the distance of one-third of its length, measuring from the point at which the disc is attached; press a small agate or glass capsule into the aperture without any wax or fixture; the elasticity of the wood or quill keeps it sufficiently firm; balance it on a fine steel point, and let a cover be put over it. This instrument moves to the influence of the solar beam from morning to evening in our shortest days, even when the thermometer stands at freezing, and though the rays fall upon it through the glass of a window and the glass of the cover: the motion of the balancing bar is as slow, equal, and constant, when the sky is clear, as the shadow of the gnomon of a dial. Mr. Watt has also observed, he says, that this instrument and several other bodies clearly indicate by their motion the attractive influence of the lunar beam.—*Jameson's Journal,* 1828, p. 400.

II. Chemical Science.

1. *On the Conducting Power of Bodies for Heat, and on a new instrument called a Thermometer of Contact, by* M. Fourier.—A memoir on these subjects by M. Fourier is inserted in the 'Annales de Chimie, xxxvii. p. 291,' which contains not only the description of two new instruments, with their applications and some novel results obtained by their means, but also the mathematical developement of the theory of these instruments, and of the experiments made with them.

The instrument called a *thermometer of contact*, consists of a conical vessel constructed of very thin iron, with the exception of the bottom, which is made of thin pliable skin; it is filled with mercury and has a thermometer, the bulb of which is immersed entirely in the mercury, and the scale has degrees of such magnitude that they may be divided into tenths. The skin must be preserved perfectly clean and never be overheated: it is better than any other similarly flexible substance, because of its superior conducting power. This instrument is to be accompanied by a support consisting of a block of marble; and any substance operated upon is to be in sheets or reduced to thin plates. When an experiment is to be made, the sheet, cloth, or thin plate is to be placed upon the marble, both being at the temperature of the room; the conical vessel, with its contents, is to be heated on a stove or other hot body, until about 46° or 47° C.; and then being removed, at the moment it has fallen to 45°, it is to be placed on the substance to be tried; the time when it arrives at 40° is to be exactly noted by a watch, and then the temperature noted minute by minute for five minutes. If the experiment be repeated with the same substance on another part of the marble, exactly the same results will be obtained, provided the temperature of the place has not changed. If the experiments are to be made on rigid plates, then these are not to be placed directly upon the marble, but upon a mercurial cushion, made by confining mercury under a surface of skin.

If the substance first tried be replaced by another, and then the fall of temperature in a given time be noted, the variation will be found very sensible, however slight the difference between the substances; the addition of a single sheet of the finest paper makes a great difference in the effect. The slightest difference in the nature of the stuff is immediately indicated. If a piece of linen cloth be replaced by flannel, or by woollen cloth, or a thin piece of woollen cloth by a thick piece, not only are the differences produced very evident, but they can be obtained over and over again with the utmost constancy, care being taken that the pressure of the mercury upon the skin, and therefore upon the substance, be the same in all cases.

The same instrument also indicates the heat of contact of bodies. In such cases, after being heated as before mentioned, it is

to be placed on a thick mass of the substance to be tried, and the fall of temperature in a given time noted as before; striking effects were thus obtained. Being first applied to iron at the temperature of 8° C., and then upon a mass of stone, the difference at the end of the second minute was 5°. The differences are much greater when iron is compared with brick or wood.

Although the conducting powers thus obtained for different substances are only approximations, yet there are many bodies, as bricks, stones, wood, clothing, &c., for which these are quite sufficient.

Another still more delicate method of ascertaining the conducting power of bodies is then described, but it is also more difficult. Two vessels are used; the lower one is maintained at a constant temperature, as 100° C.; upon that is placed the substance to be tried, and upon that again the upper vessel. The lower part of the upper vessel is inclosed, and constitutes the bulb of an air thermometer; the upper part is retained at the temperature of ice; the air therefore in the thermometer is cooled by the ice and warmed by the lower heated vessel; the latter producing an effect greater or smaller according to the nature of the substance between it and the air-vessel; the temperature of the air and the indication upon the scale connected with it soon becomes permanent, and as it is higher or lower, indicates the greater or less conducting power of the interposed substance. When the experiments are carefully made, they accord with those of the former instrument, but are more delicate.

By means of these instruments, M. Fourier was able to ascertain that many substances when put together conducted heat differently, according to the order in which they were placed. Two pieces of cloth being put between the instrument and the marble, the order of substances traversed by the heat, was skin, cloth—cloth, marble. After observing the effect, a thin plate of copper was placed between the cloth and the marble; the fall of temperature was then slower than before: the copper was then placed between the pieces of cloth, and the cooling was as if no copper were present; then placing the copper beneath the skin of the instrument and above the cloth, so that the order was skin, copper, cloth, cloth, marble, the temperature diminished more rapidly than if no copper had been there: thus the interposition of the metal facilitated the transmission of heat from the skin to the cloth, but diminished the transmission from the cloth to the marble.

2. *On a Method of Measuring many Chemical Actions.*—M. Babinet proposes to measure chemical action in cases where gases are generated, by ascertaining the force exerted by the gas evolved. The general cases enumerated are those in which hydrogen, nitrous acid, oxide of azote, carbonic acid, chlorine and sulphurous acid are disengaged. "If the operations

are carried on in close vessels, when the gas acquires a sufficient elastic force, *the chemical action will stop;* it is *suspended* until the moment when freedom is given to the compressed gas, the force of which in some sort makes an equilibrium to the chemical action which tends to disengage it." It is this elastic force which M. Babinet proposes to use as a measure of the action of different substances at various temperatures.

In 1818, a copper shell closed by a stop-cock was filled with zinc, water, and sulphuric acid, and being left on the snow it did not burst. In 1819 a copper tube was filled with the same substances, but it again was strong enough to resist the efforts of the gas to burst it. A vessel was then prepared and supplied with a gauge, in which the height of the mercury was to "give the elasticity of the gas at the moment when the equilibrium was established and the chemical action counterbalanced." At 25° C. (77° F.) the hydrogen disengaged from water, zinc, and sulphuric acid surpassed 33 atmospheres.

Another experiment was made by attaching a small copper globe to the apparatus, allowing communication between the two, then removing the globe and ascertaining how much gas it contained at 10° C. (50° F.) The globe, removed from the preceding chemical re-action, was found to contain thirteen times as much gas as under the ordinary pressure of the atmosphere; "the disengagement was therefore arrested here with a force of thirteen atmospheres."

At 0° (32° F.) M. Babinet supposes the force of hydrogen gas would be much feebler, and, employing iron instead of zinc, still more feeble. At ordinary temperatures, chlorine from muriatic acid and oxide of manganese has an elasticity not much more than two atmospheres.—*Ann. de Chimie,* xxxvii. 183.

We are uncertain what is M. Babinet's real meaning, though we quote his words accurately. That the chemical action is not *arrested* by the pressure from the evolved gases, or even influenced, except in the destruction of that mechanical action, which, when gases are evolved, is so active in mixing the ingredients concerned together, has been sufficiently shown in Mr. Faraday's experiments upon the liquefaction of gases. When carbonate of ammonia and sulphuric acid are put together and sealed up hermetically in a tube, although the evolution of carbonic acid *gas* ceases in a few hours or a day or two, still the chemical action goes on, and the evolution of *liquid* carbonic acid continues until no more of the carbonate remains to be decomposed. The same is the case with muriate of ammonia and sulphuric acid, and with many other mixtures. M. Babinet's process might give the elastic force of the gases or vapours of the substances produced, and be so far a measure of the mechanical effects of some chemical actions, but nothing else.—*Ed.*

3. *On the formation of Fulgorites, or Lightning Sand Tubes.*—Some

very fine fulgorites have been shown in Paris and London * by Dr. Fiedler, procured from Westphalia. Some of them, which, although not put together, have been exhibited in fragments and in drawings, were 19 feet long. These tubes consist of sand vitrified on the internal surface, and rough on the exterior; they are formed by the passage of lightning through a sandy stratum; and although this has been well determined, yet M. Hachette thought it might be well to add, to the knowledge already obtained, some experimental proofs of the effect of powerful electric discharges through powders of a convenient degree of fusibility.

The most powerful battery in Paris was employed, and the electricity accumulated in it discharged through powdered glass pressed into a hole made in a brick; tubes exactly similar to *fulgorites* were obtained, except that they were small and proportionate to the size of the electrical apparatus used. One was 25 millimetres (0.984 inches) long, the external diameter, diminishing irregularly from one end to the other, was from 0.118 to 0.059 of an inch, and its internal diameter 0.0197. In another experiment, made with glass and common salt mingled together, a regular tube 1.18 inch long was obtained, externally 0.157 of an inch wide, and internally of half that width.

Experiments made with powdered quartz and felspar did not succeed. The tubes, obtained as above, exactly resembled those formed naturally, in the brownness of the internal surface, but were very far short of them in solidity and strength,—a difference to be anticipated from the nature of the agents used.—*Annales de Chimie*, xxxvii. 319.

4. *Preparation of Hydriodic Acid Gas.*—The following process is by M. Felix d'Arcet. Hypophosphoric (hydro-phosphorous?) acid is to be evaporated until upon the point of evolving phosphuretted hydrogen gas, when it contains no more water than is essential to its composition. It is then to be put into a small tube closed at one extremity, and its weight of iodine added; on applying a gentle heat, hydriodic acid gas is liberated, and continues to be evolved for a long time. The gas is perfectly pure, being free from excess of iodine; it may be collected over mercury without the formation of any iodide of mercury, or by letting the conducting tube descend to the bottom of the collecting jar in the ordinary manner for heavy gases. 90 or 100 grains of the acid gave as much as 120 cubic inches of hydriodic gas, pure and entirely absorbable by water.

The residue of the operation is a mixture of phosphoric acid, and the compound of hydriodic acid and phosphuretted hydrogen. —*Annales de Chimie*, xxxvii. 220.

5. *Test for Nitric Acid and its combinations.*—*Runge.*—Pour a solution of protomuriate of iron upon the surface of an amalgam of

* See Proceedings of the Royal Institution, p. 434 of this Number.

zinc, and then place a crystal of nitre upon the latter in the fluid; a dark band immediately forms around the crystals, sometimes extending over the whole surface of the mercury. All the nitrates, as well as nitric acid, act in this manner; but other salts, as the chlorate, produce no effects of the kind; so that a very sensible test of the presence of nitric acid is thus afforded. It is necessary that the solution employed be a protosalt of iron. If nitric acid is supposed to exist in a liquid, it should be saturated with potash, evaporated to dryness, and the dry mass tried. Of course, salts of copper or of silver must not be present.

When an amalgam of brass is used instead of zinc, those effects are not produced; which M. Runge considers as a proof that the zinc or brass is combined, *chemically*, with the copper.—*Annalen der Physik*, 1827, p. 479.

6. *On the decomposition of Ammonia by the Metals.*—It has usually been supposed, that when ammonia has been decomposed by the metals, as iron, copper, &c., the latter did not increase in weight; and although it had been remarked that they became brittle, it was considered as the result of some alteration in the arrangement of their particles. M. Savart, engaged in researches on the elasticity of bodies, had occasion to assure himself that there really was no increase in the weight of the metals used; and although he acknowledges that his experiments are as yet imperfect, still finds reason to believe the ordinary opinion erroneous. 141.91 grs. of thin copper wire were employed to decompose ammonia for four hours, and then had become 142.382, having increased 0.472. As the wire was slightly oxydized, the experiment was carefully repeated with 28.86 grs. of copper wire, the ammoniacal gas being dried, and every other precaution taken: the weight increased to 28.965, so that the wire had increased $\frac{1}{275}$ of its weight, and had absorbed 0.105 of an unknown substance. The properties of the copper had been altered in the usual manner, and the specific gravity of the wire, which had been 8.8659, was now 7.7919.

Iron produced exactly the same effects, except that the increase in weight was less. A cylinder, weighing 40.135, was used to decompose dry ammonia for nine hours, and then weighed 40.195, the increase being only 0.06 or $\frac{1}{670}$. This accords with some experiments made by M. Thenard. The properties of the iron are much changed by the operation, as has been observed; it is more brittle than before: but further, if left for an hour or two only in the heated gas, its grain differs from that of ordinary iron, and resembles that of steel; it may then, also, be hardened and tempered, and will strike fire with flint like ordinary steel. If the action has continued for eight or ten hours, then the iron is not affected by the hardening process; it is softer than ordinary iron to the file, has a grey black fracture, its grain partly resembling plumbago. The specific gravity of the wire before the operation was 7.788; after, 7.6637.

As it appeared, from these experiments, that either nitrogen, hydrogen, or perhaps ammonia, was absorbed, MM. Savart and Porzos heated 49 grs. of the altered copper in a small porcelain retort, but could obtain no liberation of gas, although the heat was high and the copper fused. When cold, the copper was found in one lump, but between it and the porcelain was a substance, partly imbedded in the glaze of the porcelain, of a yellow brown colour, and having a greater specific gravity than copper itself. The copper re-weighed amounted to 48.9; having lost $\frac{1}{490}$ of its weight, and abandoned the largest part of the substance which had been combined with it. When potassum was made to act upon the substance adhering to the porcelain, it appeared to have an action exactly like that of the same metal on ammonia.

[illegible] Savart then remarks, that these experiments, imperfect as [illegible] are, accord with and support those of MM. Davy and Berzelius, [illegible] by other researches, have been led to consider azote as [illegible] of a base, and this substance, which they have called [illegible]ium, may be the body which has formed alloys with the [illegible] iron in the experiments described.—*Annales de Chimie*, [illegible]26.

7. *Preparation of liquid Ammonia.*—Bizio.—A tubulated retort is to be put into a sand-bath, and connected with a small balloon placed on a little furnace; a tube is to proceed from the balloon to a flask which is to be supplied with a safety tube, and with another tube dipping into a mercurial bath. Equal parts of sal ammoniac and hydrated lime are to be used; the lime is to be made into a cream with water, and put into the retort, and then the powdered sal ammoniac added; after being well mixed the retort is to be closed; water, equal in weight to the sal ammoniac, is to be put into the flask; the retort in the sand-bath to be heated, and the balloon moderately warmed. As the ammoniacal gas is disengaged it will be absorbed by the water in the flask. By managing the fire properly, and distilling the portion of impure ammonia in the balloon, pure ammonia of the s. g. of .910 will be obtained, 16lbs. being produced for every 10lbs. of sal ammoniac employed. M. Bizio says, that the ordinary processes do not give more than one-half of this quantity.—*Bull. Univ. C.* xii. 88.

8. *Solubility of certain Substances in Sulphuric Acid.*—Vogel observed, that anhydrous sulphuric acid dissolved sulphur, forming a blue, green, or brown solution, according to the quantity present. Water precipitated the sulphur.

Müller found, a long while ago, that pulverized tellurium dissolved readily in concentrated sulphuric acid, forming a transparent deep red solution; no gas or peculiar odour was developed; water precipitated the tellurium.

Selenum dissolves in sulphuric acid, forming a green solu-

tion precipitated by water. An analogy holds between these three substances in this respect.

Iodine, according to Bussy, also dissolves in sulphuric acid.—*Annales de Chimie*, xxxvii. 189.

9. *On the Presence of Columbium as well as Titanium in Iron Slag.*—The iron slag of Königshütte, in Upper Silesia, has been examined by Professor Hünefeld, in consequence of its having been shown by Karsten to contain abundance of titanium, like that first pointed out by Wollaston in the iron slags from South Wales. But besides titanium, Professor Hünefeld found great reason to believe in the presence of columbium, or, as he calls it, tantalium, in considerable quantities. Besides the cubes of titanium, he found in the slag, 1. Granules of metal melted into it of the shape of beans or spheres, weighing from 2 to 30 grains. 2. Cavities of different sizes, the sides of which, when filed, had a steel lustre. 3. Grains of metal sprinkled through the slag, of a globular or oblong shape, with a metallic lustre, and a colour between those of silver and tin. In their chemical properties, they resembled the small lustrous metallic bases before described; they scratched glass, gave a shining powder, and seemed, therefore, to be tantalium, such as we have found it hitherto described. 4. Melted grains of metal partly globular, with a tint verging upon the colour of brass. 5. Portions of melted slag, of a dark rose-red colour, which exhibited a fine lustre when filed, and were hard and tough, but not malleable.

No. 3 was the most striking of these products. The grains scarcely lost anything in aqua regia, preserved their lustre, and did not crumble. Similar granules, which remained behind in another experiment with the same solvent, scratched glass, and, when beaten and broken with a hammer, made red-hot with caustic potash, and treated by the blowpipe as well as with humid tests, did not give any indications of titanium. A portion, however, which had been melted with potash, and acidulated with nitric acid, the solution exposed for several days to the air, and afterwards filtered, was, by means of a solution of galls, precipitated rather abundantly of a dirty orange colour, whilst hydrosulphuret of potash produced a scarcely perceptible turbidity.

Numbers 1, 2, 4, and 5 seemed to be different mixtures of iron, titanium, and columbium.—*Phil. Mag. N. S.* iii. 121.

10. *On Electrical Phenomena produced by Pressure, and the Cleavage of Crystals, by* M. Becquerel.—In continuing researches commenced, and in part published some years since, on the developement of electricity by pressure, M. Becquerel's object has not been to ascertain whether the electricity was due to any other cause than that which is effective when friction is resorted to, but to see how pressure, which may be considered as an element of friction,

affects the developement. The instrument he used was a balance of torsion, the wire being of platina, exceedingly fine, and drawn by Wollaston's method. By the aid of this instrument it was ascertained, that when badly conducting substances were experimented with, and a convenient velocity of separation obtained, the intensity of the electricity disengaged was proportional to the pressure, *i. e.* a double pressure gave a double intensity; the law, however, diminishes no doubt as the pressure is increased, either as the molecules lose their faculty of being compressed, or as the surfaces of contact alter. By submitting different mineral substances to the pressure of the same body, their electric relation has also been ascertained, and in this way it was found that Iceland spar had thrice the power of sulphate of lime.

When two bodies are pressed together, and the pressure is then diminished without the contact being changed, the electric effect remains some time after the partial removal of the pressure, according to the conducting power of the bodies; so that they may be removed from each other, and yet retain an electricity greater than that due to the *last* pressure. A disc of cork was pressed against a crystal of Iceland spar with a force of 4 kilogrammes; the pressure was then reduced to two kilogrammes, and a minute after the pieces were separated: the electricity of the cork was then 170; that produced by the original pressure would have been 250: so that it is sufficiently evident the effect of the greater pressure had remained some time after the pressure itself was lessened. If, on repeating the experiment, in place of separating the two pieces, the pressure is restored to 4 kilogrammes, then diminished, and again restored several times, the disc of cork will ultimately be found to have an electricity of 250, or no more than that due to the highest pressure given.

Hence it results, that if two bodies, one a bad conductor of electricity, are pressed against each other with a certain force, and the force be diminished and increased several times without any change in the place of contact, each of these bodies, when freed from the compression, will exhibit only the quantity of electricity due to the highest pressure. The effect is to complete in each body that quantity of electricity which it should receive in proportion to the highest pressure.

Electricity due to Cleavage.—Different bodies, which adhere together, exhibit electricity upon their surfaces when separated, the two bodies being in opposite states. Glass and gum-lac produce this effect with mercury, and gum-lac with glass. In the phenomena of compression also, when adhesion takes place, as between two pieces of cork, the electricity is greater than when there is no adhesion. These effects are eminently distinguishable when cork or elder-pith is pressed against the polished faces of a diamond.

The electrical phenomena due to pressure and those of cleavage

have a great analogy with each other. When plates of mica or sulphate of lime are suddenly separated, each surface is electrical, the two being contrary to each other; if they be put together again, and slightly pressed, upon separation they exhibit the same electrical phenomena as before. Hence the pressure which mechanically causes the approximation of the particles produces the same effects as the force of aggregation, which in reality only occasions a more immediate contact of the same particles.

Every substance, regularly crystallized, possesses the same property as mica and sulphate of lime. To obtain the effect, it is necessary that the cleavage be regular and perfect; if it be irregular, some plates take one electricity and some another, and the effects are no longer distinctly observed.

The kind of electricity acquired by the different surfaces varies according to circumstances not yet ascertained. The topaz has only one cleavage, and that perpendicular to the axis of the crystal, but no regularity is observed in the nature of the electricity; for sometimes the surface towards one end and sometimes that towards the other, takes the same electricity.—*Annales de Chimie*, xxxvi. 265.

11. *On the Velocity of Sound in Water.*—Experiments on the velocity of sound in water have been made by M. Colladon on the Lake of Geneva, and are connected with researches by himself and Sturm on the compressibility of fluids. The space through which the sound passed was about 45,000 feet (13487 metres). The sound was produced by striking a large bell suspended in the water, and was heard by means of a peculiar apparatus, so constructed that the person who listened for it could also observe the signal at the bell, and both set going and stop the time-piece. The mean of several experiments was 9.4 seconds, for the whole distance: on dividing the distance by the time, the velocity of sound on the water of this lake was 1435 metres, or 4708 feet per second.

The water being examined, gave one six-thousandth of its weight of saline matter; and its specific gravity at 40° Fahr. was 1.00015.

M. Colladon remarks that the sound of a bell heard at some distance under water is strikingly distinct from that of the bell in air, being a short, brief noise, similar to that produced by striking two knives together. If the distance be increased, still the character is preserved, and it is impossible to distinguish whether the original blow is strong but distant, or nearer and weaker. It is only within the distance of 200 metres that the ringing of the bell is heard: in air the reverse of this takes place; the blows struck upon a bell are easy to distinguish near at hand, but at a distance melt into one continuous sound. This phenomenon depends upon the nature of the sonorous vibrations in water. In fact, it is known that in the vibratory motion of a fluid the duration

of the motion of a particle is equal to the radius of the spherical portion of the fluid supposed to be agitated at the origin of the motion, divided by the velocity with which the sound is transmitted. The first of these qualities is necessarily smaller in water than in air; the second greater: from whence it follows, that the duration of the sound should be much less when transmitted by water than when by air.

A second remark is, that sound is not transmitted from water to air when the direction of the vibrations forms a very small angle with the surface at which the two fluids meet. When the bell 6.56 feet below the surface was struck, the sound could be heard in the air at the surface of the water at the distance of 200 metres (656.17 feet); but at a greater distance it diminished rapidly, and at 400 or 500 metres could not be distinguished. If, however, the head were immersed a little way in the water, or a trumpet-formed tube, full of air and closed by a diaphragm, were immersed, so that the diaphragm should be perpendicular to the line extending directly to the bell, then the sound could be heard even at ten or twenty times that distance.

The agitation of the waves produced no alteration in the velocity, duration, or distinctness of the sound under water, when a tube like that just mentioned was used to render them audible. Some of the experiments were made at very stormy periods, but with no observable difference on these points.—*Annales de Chimie*, xxxvi. 236.

12. *Extraordinary Experiments on Heat and Steam, by* Mr. Perkins.— Under this title are described in the last number of this Journal, (p. 461,) some results, stated to have been obtained by Mr. Perkins, from an American journal. The details are so circumstantial that we cannot resist the inclination of quoting another experiment of the same kind from the French journals.

A generator is said to have cracked when very hot, but no vapour or water issued out until the temperature was allowed to fall, and then the rush of steam by the aperture formed was tremendous. This was supposed to be because the heat repelled the water and vapour to a certain distance from the metal, and, virtually, stopped the crack; accordingly, another day, the generator was heated red hot at the cracked part, and water introduced in the usual way: neither steam nor water came out at the crack during the whole of the day, the generator being at work all the time; but in the evening, on cooling it, the same effects happened as before.

As some persons still retained doubts, *all* these, it is said, were removed by the following experiment: a hole, the eighth of an inch in diameter, was made in one of the extremities of one of the tubes of a generator, and an iron tube, three feet long, one inch external and half an inch internal diameter, screwed over it. The

open end of this tube had a small cock, and at the other end of the *generating* tube was fixed a safety-valve with a pressure of 50 atmospheres on each square inch; to the same end was also fixed the pipe by which the forcing pump threw in water. After having made the pierced extremity of the generating tube red hot, water was introduced; the vapour formed escaped by the safety-valve, although charged to the extent above-mentioned, and yet, upon opening the stop-cock of the iron tube, *nothing* came out. The fire was then diminished, and when the temperature had sunk sufficiently, the escape of vapour was so great as to produce a terrible noise.

The repulsive power of the heated metal was sufficient, says Mr. Perkins in reasoning upon the effect, to retain the *vapour* and the water equally distant; for what else is vapour than water in a state of expansion? The repulsive force in this account is said to be exerted to the distance of the sixteenth of an inch, for the hole was the eighth of an inch in diameter.—*Annales de Chimie*, xxxvi. 437.

13. *Iodides of Carbon, by* M. Mitscherlich.—Whilst experimenting for a peculiar purpose, M. Mitscherlich mingled the alcoholic solutions of iodine and soda. "There was formed immediately the compound obtained by Serullas. But Serullas, to whom we are indebted for a great many interesting experiments on this compound, says, that there is formed simultaneously iodate of soda, iodide of sodium, and hydriodide of carbon; but I have not found the slightest trace of iodate of soda. On decomposing the substance discovered by Serullas by means of copper, iron, and mercury, I obtained no hydrogen, nor any other kind of gas, but only a combination of iodine and carbon. We should, therefore, consider this substance as a compound of carbon and iodine formed in the following manner:—when the two alcoholic solutions are mixed, the iodine combines with the sodium, and the oxygen, set free, unites to the hydrogen of the alcohol to form water; whilst the carbon of the alcohol (the latter being considered as a compound of water and olefiant gas) combines with another portion of the iodine, to produce the iodide of carbon."

"This iodide of carbon, distilled with corrosive sublimate, yields a liquid analogous to that which Serullas obtained by employing dry chloride of phosphorus. It is also a compound of carbon and iodine; so that we now know two combinations of iodine and carbon, and one of iodine with carburetted hydrogen, discovered by Faraday, which is distinguished from the two other by its chemical properties and crystalline form.—*Annales de Chimie*, xxxvii. p. 85.

The experiments of M. Mitscherlich, by showing the true nature of M. Serullas' compound, remove the difficulty of supposing that two hydriodides of carbon could exist of exactly the same composition, but different in properties."—Ed.

14. *Method of discovering Potassa by the Blow-pipe Flame.*—M. Harkort of Freyberg says, that, in consequence of an observation made by Kirwan, namely, that oxide of Nickel with potash, gave a blue glass before the blow-pipe, whilst soda with the same oxide produced a brown glass, he was led to examine whether the distinction might not be made to afford a useful test. On making the experiment with potash, he obtained an excellent result; the blue produced is not likely to be confounded with that produced by cobalt, because it inclines to a milky appearance. So sensible is this test, that the presence of potash was readily discovered in the *periclinite* (a new variety of felspar, distinguished by Professor Breithaupt,) although existing there in very small quantity. The experiment relative to soda was not so successful, the glass acquiring only a weak brown colour.—*Jahr. der Chem.* 1827.

15. *New Variety of Borax.*—M. Payen, a manufacturer of borax, observed in his vessels crystals differing from the ordinary crystals of borax in hardness, and in their smaller proportion of water: by examining the circumstances, he was, ultimately, able to obtain this new variety at pleasure, and in any quantity.

The new borax is in regular octoedrons; has a specific gravity of 1.815 instead of 1.74; is harder than ordinary borax; has a bright conchoidal fracture; does not break like common borax by the sudden application of 30 or 40 degrees of heat. Ordinary borax remains transparent in moist air or in water, but becomes opaque in dry air; the reverse, in both cases, takes place with the new borax. It contains 30 per cent. of water; ordinary borax contains 47 per cent. The crystals are very sonorous, and, unlike those of common borax, are aggregated strongly together, so as to cut like one solid mass.

In soldering, the new borax will be more advantageous than the old, because it swells less and flows more readily. Where the borax is to be dissolved, the common kind is best, as being more easily soluble. As respects carriage, it has an advantage equal weights of the two having values as 70 and 53; and equal bulks having values as 70 and 60. The crystalline forms and other characters are so distinct, that the one kind of borax can very readily be distinguished from the other in commerce.—*Ann. de l'Industrie,* i. 74.

In a second paper on the same subject, M. Payen has told us how to obtain these peculiar crystals. If borax be dissolved in water at the temperature of 212° Fah. in such quantity as to give a solution of specific gravity 1.246 and it be then left to cool slowly and regularly, small octoedral crystals begin to form at the temperature of 174° F. which increase in number and size until the temperature is 133°. If the mother liquor be then decanted, all the crystals left are of the kind before described: nearly all the crystals formed from the mother liquor after this point are borax of the ordinary sort. If the density of the boiling so-

lution of borax be not higher than 1.170, then only ordinary crystals are obtained; so that one or the other may be procured at pleasure.

M. Payen then proceeded to ascertain the atomic weight of boracic acid, and of some borates in various states. Weighed portions of pure and anhydrous borax were dissolved in water and converted into both crystallized forms, and the increase of weight ascertained: 100 parts of prismatic borax were found to contain 46.95 of water; and 100 parts of octoedral borax, 30.64 of water.

Then boracic acid was purified by repeated crystallizations, and, ultimately, fused: subcarbonate of soda was also prepared with the utmost care, by crystallization and conversion into bicarbonate, and then fuzed. A given quantity of the latter was then dissolved in water, heated, and boracic acid added until all effervescence ceased. To ascertain that equivalent proportions had been used, the borax formed was crystallized; the mother liquor withdrawn, examined, and again crystallized; and this was carried on until the whole had become borax. It was easy to ascertain with a very minute drop of the mother liquor, whether carbonate of soda or boracic acid were in excess: in the first case a little sulphuric acid caused effervescence; in the second, a little solution of soda instantly caused a crystallization of borax.

In this way 2.002 of dry subcarbonate of soda required 2.64 of dry boracic acid, and produced 7.185 of the ordinary crystals of borax, which, according to the previous experiment, being equivalent to 3.8116 of dry borax, gives 0.8304 for the carbonic acid set free from the alkaline carbonate.

Upon using some very pure crystallized boracic acid in place of that which had been fuzed, it was found that the 2.002 of carbonate of soda required 4.660 to produce borax as before; from which it may be concluded that the 4.66 contained 2.02 of water.

From these results the following atomic compositions are drawn, oxygen being 10.

Pure boracic acid	1 atom	44
Water	3	33.73
Crystallized boracic acid		77.73

	Anhydrous Borax.		Prismatic Borax.		Octoedral Borax.	
Boracic acid	2 atoms	88.	2 atoms	88.	2 atoms	88.
Soda	1	39.09	1	39.09	1	39.09
Water			10	112.43	5	56.217
		127.09		239.52		183.307

Ann. de l'Industrie, v. 156.

16. *On the Chloride of Lime, or Bleaching Powder, by* M. Morin.—The uncertainty of the sulphate of indigo, as a test liquor for chloride, has been long known. M. Morin proposes to substitute for it a solution of muriate of manganese. The same vessels as in Gay Lussac's chlorometer may still be used, but a volume of this new test liquor will represent 10 volumes of the old solution of indigo,

so that the only change necessary will be to use ten times as much of the solution of chlorine to be tried, as was taken upon the former system, whilst the strength of the solution will be estimated in the same degree as before.

When muriate of manganese is poured into solution of chloride of lime, the muriatic acid takes the lime, brown oxide of manganese is precipitated, and the chlorine disengaged. The quantity of liquid decomposed corresponds exactly to that of the chlorine disengaged. In this case the disengagement of the gas is the result of a reaction, and the latter may be effected either very slowly, or in an interrupted manner, without any sensible difference in the estimation. The liquid will keep for many months without change; but as at length a small brown deposite is formed, it is well to add 10 drops of muriatic acid to each litre (61 cubic inches) of the proof liquor. Supposing the substance will not keep indefinitely, still it may be remarked, that a diminution in strength is of much less consequence than variations in trials made at the same time. The value of the liquor is at any time readily ascertained, or its strength corrected.

M. Morin's memoir contains a long series of experiments upon the effects produced by variations in the proportion of water, by heat, air, time, upon the substance. His results are not in accordance with Dr. Ure's, but agree with M. Welter's.

The hydrate of lime, consisting of 2 proportions of water, and 2 of lime, is that which absorbs the largest quantity of chlorine. If otherwise constituted, the chlorine is proportional to the body in smallest quantity; and, in such cases, the excess of lime, or of water, is a pure loss in the chloride. Two proportions of quick lime dipped into water, and taken out, contain about 2 proportions of water; but, after being allowed to slake, they retain little more than one proportion of water. The manufacturer should be careful to add a quantity of water equal to that which has evaporated: a little excess is much better than having an excess of lime.

When bleaching powder is prepared, the temperature should be kept low: when made quite cold, it always marked full strength or 100° upon the chlorometer, all the chlorine being then in an effective state as chloride of lime; but when the heat was allowed to rise, the chloride sunk in value to 66°, so that one-third of the chlorine was lost, and that was the case whatever the temperature was between 30° and 119° (86° and 246° Fah.): no oxygen was disengaged, but chloride of calcium and chlorate of lime formed at such times. In all these experiments, 2 proportions of hydrate absorbed 1 proportion of chlorine.

When the chloride of lime in powder is carefully heated, a considerable quantity of chlorine is given off at first, and then oxygen. If the solution be heated, pure oxygen is evolved, and by ebullition all the chloride of lime is destroyed.

The following appears to be the composition and condition of

the chlorides of lime at different periods. Welter's chloride at 100°, or full strength, consists of 18 atoms of chlorine, 36 of water, and 36 of lime. This, when it becomes the dry chloride of 66°, as before mentioned, consists of 12 atoms of subchloride of lime, 5 of chloride of calcium, 1 of chlorate of lime, 6 of hydrate of lime, and 6 of water. When this is dissolved in water, 18 atoms of lime separate, and there remain in solution 5 atoms of chloride of calcium, 1 of chlorate of lime, and 12 of neutral chloride of lime. The latter being evaporated, is converted into 1 atom chlorate of lime, and 17 chloride of calcium.

A solution of chloride of lime, out of contact of the atmosphere, undergoes a slow change at common temperatures, whether in the light or dark, and pure oxygen is evolved, chloride of calcium being formed. The same change takes place with chloride of lime; exposed to the air, it becomes converted entirely into chloride of calcium, atom for atom, evolving oxygen proportionate to the chlorine present. This effect differs from that produced by heat, when one-third of the chlorine forms chloride of calcium and chlorate of lime.

Manufacturers should be careful to make their bleaching powder at as low a temperature as possible. In summer it is almost impossible to avoid the injurious evolution of heat. In winter it is less difficult, but the operation should be always conducted in a place as cool as possible, or one-third of the chlorine will be lost. From the effects of heat, and of excess of lime or water in the hydrate, bleaching powders of very low value are often sent into the market even below 50°. The chloride should always be preserved in well-closed vessels, and in a cool place, that the spontaneous change may be retarded as much as possible, and the contact of air, which is injurious, by giving water as well as carbonic acid, be prevented.—*Annales de Chimie*, xxxvii. 139.

17. *On a Gaseous Fluoride of Manganese, by* M. Wöhler.—Ordinary chameleon mineral was mingled with half its weight of powdered fluor spar, and acted upon by sulphuric acid an instant disengagement of purple red vapours in large quantity took place. The same experiment was made in a platina retort, and the gas conducted into a platina crucible containing a little water; it was absorbed, and the water acquired the purple colour of manganese, and was acid in properties. On opening the retort before the action was over, it was found filled with a *yellow gas*, instantly turning purple by contact with the air. To prove that the yellow gas did not arise from nitre, a pure crystallized manganesiate of potash was made by heating to dull redness equal parts of hydrated potash and peroxide of manganese. This, mixed with its weight of powdered fluor spar, free from silica, was acted on by sulphuric acid as before, the gas passed first into a glass receiver and from thence into water. For the first moment the receiver was filled

with a greenish yellow gas, but this soon disappeared from action upon the glass; the latter was strongly corroded and covered with a brown substance, which gave an intense purple colour to water. The water into which the gas passed soon became red, and was covered with a crust of rose-coloured silica. On dismounting the apparatus, the glass receiver was found filled with fluo-silicic gas; and the retort, as before, with a yellow gas, becoming purple instantly in the air. Hence it appears that a gaseous fluoride of manganese was formed, of a greenish yellow colour, which, with air, formed a red purple cloud, dissolved in water, producing a red purple colour, and was decomposed by glass into manganesic acid and fluo-silicic gas. No appearance of condensation took place in the neck or other parts of the apparatus.

In one experiment the neck of the retort was filled with fused chloride of calcium to dry the new substance, but the fluoride was violently decomposed; the neck of the retort rose to a high temperature; not a trace of gaseous fluoride of manganese appeared, but much pure chlorine.

The red solution of the gas in water rapidly dissolved copper, mercury, and silver, without the evolution of gas; fluoride of silver, &c. and a protofluoride of manganese being formed. The purple red solution has been preserved for months in glass vessels without change. When evaporated slowly in a platina vessel, it continually developes oxygen and vapours of fluoric acid; and there remains a brilliant brown substance, which, by water, is converted into a black subfluoride of manganese.—*Annales de Chimie*, xxxvii. 101.

18. *Boruret of Iron.*—Lassaigne.—Prepare a sub-borate of iron by precipitating persulphate of iron by borax; wash and dry the precipitate, form it into a paste with water, and mould it into a small cylinder; when dry, place this cylinder within a porcelain tube, heat it red hot, and pass pure dry hydrogen over it. Boruret of iron is formed; it acts slightly on the magnetic needle, and consists of 77.43 of iron, 22.57 of borax, or one atom of each, nearly. —*Bull. Univ.* A. ix. 135.

19. *Decomposition of Salts of Copper by Ebullition.*—MM. Colin and Taillifert have said, that when the blue or green carbonate of copper is boiled with water, it became anhydrous and black, but retained all its carbonic acid. M. Gay-Lussac finds this to be incorrect, and that the black powder is nothing else than anhydrous oxide of copper. If the ebullition be stopped so soon as the carbonate appears black, then the product will effervesce with acids; but that is merely a consequence of incomplete change, the product being, in such cases, a mixture of carbonate and oxide. All the carbonates of copper tried, lost their carbonic acid by this process.

Acetate of copper is also decomposed by ebullition; the acetic acid flies off, and a brown oxide of copper remains

When carbonate of soda is added to sulphate of copper in excess, the precipitate obtained is a *subsulphate* of copper; this salt does not change by ebullition. Sulphate and carbonate of zinc boiled together also produced a subsulphate of zinc.—*Annales de Chimie*, xxxvii. 335.

20. *Discovery and Separation of Antimony from Lead, Copper, &c.*—If an alloy, containing tin, but no antimony, be dissolved in nitric acid, all dissolves except the tin, which separates as a white oxide; but if antimony be present, in however small a quantity, the oxide of tin acquires a yellow colour. When tin is precipitated by nitric acid, it has the power of taking all the antimony present with it. M. Bussolin, who remarked these facts, has employed them usefully in the distinction and separation of antimony from lead, &c.—*Gior. di Fisica.*

21. *Singular action of Arsenic Acid on Sugar.*—When a solution of pure arsenic acid is mixed with sugar and left for a few hours, a rose colour is produced which soon becomes a fine purple, and then remains, with little further change, for many days. Sugar of milk, mannite, raisin sugar, sugar of starch, produce similar effects; but sugar of liquorice, diabetic sugar, and such bodies as starch, gum, &c. produce no effect of the kind. Nor do the soluble arseniates or arsenious acid produce these effects with the substances named above.—*Bull. Univ.* A. ix. 281.

22. *Preparation of Chromic Acid, by* M. Maus.—A hot and concentrated solution of the bi-chromate of potash is to be decomposed by fluosilicic acid; the liquid is to be filtered and evaporated to dryness; the acid thus dried is to be dissolved in as small a quantity of water as possible, and the clear fluid *decanted* from the deposit of fluo-silicate of potash which has passed the filter. The separation of this portion must not be made by a filter, for in this state the chromic acid attacks the paper, and is itself converted into oxide of chrome.

To prepare the fluosilicic acid in sufficient quantity, M. Maus uses a very large retort with a long neck: he puts into it the mixture of fluor-spar and glass, and adds sulphuric acid, to about three times the amount of the fluor spar in weight, and mixes the whole well. A large globe with a long neck is then provided, and a sufficient quantity of water put into it; the neck of the retort is introduced; the globe shaken, to moisten the interior with water, and the fluosilicic gas evolved by the application of heat. When it arrives in the globe it condenses in the water, and as soon as the quantity of silica produced retards the contact of the gas and water, the globe is again shaken and the operation continued. In this way no gas escapes, and the water soon becomes saturated with the acid; the silica is easily separated.—*Ann. der Phys.* 1827, p. 83.

23. *Solubility of Corrosive Sublimate in Ether and Alcohol by Camphor.*—Karls.—Camphor powerfully aids the solution of corrosive sublimate in ether and alcohol.

4 parts of ether	without camphor	dissolved	1 part of corrosive sublimate.
4	with 4 of camphor		2	"
4	8		4	"
4	16		8	"
4	alcohol 4		4	"
4	8		8	"

Bull. Univ. A. ix. 207.

24. *Method of preparing Ammoniuret of Silver, (fulminating Silver.)*—Chloride of silver is to be dissolved in ammonia, and fragments of caustic potash added: when the effervescence has ceased, the black liquor obtained is to be diluted and filtered; the black powder being washed and dried, detonates upon the application of heat, and is fulminating silver.—*Jour. de Phar.*

25. *Bromide of Gold.*—M. Balard observed the solubility of gold in bromine. According to M. Lampedius, 100 parts of the dry bromide contains 50 parts of gold. This substance is of a grayish-black colour; it dissolves readily in water, and then produces a deep red liquid which yields crystals of hydrobromate of gold: one grain of the crystals colours 5000 grains of water.—*Jahrbuch der Chemie.*

26. *Peculiar compound of Platina with Oxygen and Carbon.*—A compound, possessing the same curious properties as that discovered by Edmund Davy, has been formed by M. Zeize in the following manner: one part of chloride of platina, and twelve parts of alcohol of *s. g.* 0.813, are to be put into a retort, and heated slowly until the chloride becomes black, and the liquid clear and colourless. The fluid being decanted, the precipitate is to be washed with warm water until all acid is removed, and then carefully dried. If this substance be moderately heated, with or without access of air, it inflames, decrepitates slightly, and yields carbonic acid, oxygen, and water, with a little acetic acid. The same effects take place when its inflammation is occasioned by the presence of the vapour of alcohol. Ether, naphtha, or oil of turpentine, do not produce the effect.—*Bull. Univ.* A. ix. 129.

27. *Composition of Carbazotic Acid.*—M. Liebeg has been led to suspect his first results relative to the composition of this acid *, in consequence of his discovery, that it is partly volatilized when boiled, or even heated, with water. He formerly entertained a suspicion that it exhibited an anomaly in the theory of definite

* See p. 210, vol. ii. of this Journal, New Series.]

proportions, but now finds it to be in perfect obedience to it. Its composition is as follows by experiment and theory:—

		Theory.		
Carbon	35.013	36.081	15 atoms	114.65
Azote	16.167	16.714	3	53.11
Oxygen	48.799	47.205	15	150.00
	100,000	100.000		317.76

Carbazotate of Baryta.—100 parts lose, at 212° Fah. 125 parts of water; 100 parts of the anhydrous salt contain 75.72 acid, and 24.28 baryta.

Proto Carbazotate of Mercury consists of 53.79 acid, and 46.21 protoxide of mercury per cent.

Carbazotate of Lead may be formed by decomposing a salt of lead by carbazotate of potash or soda; it is a yellow powder, but slightly soluble, and detonating by heat.—*Annales de Chimie*, xxxvii. 286.

28. *On Chevreul's Acid of Indigo, by* Dr. Buff.—Dr. Buff has been engaged in an examination of the action of nitric acid on indigo, principally with a view to ascertain the relation of the substances which Chevreul formerly described as produced by this action to the carbazotic acid of Dr. Liebeg. He finds Chevreul's acid to be quite distinct from the latter. To obtain it, nitric acid of 32° (s. g. 1.285) was diluted with rather more than its weight of water, heated in a retort, and small portions of indigo in fine powder added as long as sensible effervescence was produced; a little water was added, from time to time, to prevent the formation of carbazotic acid. The yellow liquid was separated, whilst hot, from the resinous matter, and by cooling deposited crystals of the acid of indigo. This was boiled with oxide of lead, filtered, and the salt present decomposed by sulphuric acid whilst hot; on cooling, the liquor deposited the acid of indigo in yellowish white crystals; these were separated, dissolved in hot water, neutralized by carbonate of baryta, the solution concentrated, and allowed to cool; yellow acicular crystals of a baryta salt were obtained, which being washed with cold water, dissolved in hot water, and decomposed by acids, gave acicular crystals of the acid of indigo, white as snow; they were collected, and washed upon a filter, and shrunk into a small space when dry, losing almost entirely their crystalline aspect.

This acid is white, having the lustre of silk; it has a weak acid, bitter taste, reddens litmus, dissolves in any quantity in boiling water or alcohol forming colourless solutions, but requires 1000 parts of cold water for its solution. It is volatile, and being heated in a tube, fuzes and sublimes without decomposition. When the fused acid is cooled, it crystallizes in six-sided plates. In the air it burns with a bright flame, evolving much smoke Nitric acid changes it into carbazotic acid. Neither chlorine gas, nor solution of chlorine, has any effect upon it. It gives a blood-red colour to solutions of the per-salts

When decomposed by heat and oxide of copper, it yields azote and carbonic acid; the proportions of these gases in volume being 1 and 15. These are exactly the same proportions which, according to Mr. Crum, and also Dr. Buff, are given by indigo itself; so that the azote and carbon are in the same relation both in indigo and the acid of indigo. The elements of the acid, according to three experiments, are as follows:—

Hydrogen	1.73	2.03	2.417
Carbon	46.34	48.21	46 244
Azote	7 22	7.55	7.225
Oxygen	44.71	42.21	44.144

The acid of indigo combines with all bases, and has power to expel carbonic acid from carbonates The salts have a yellow colour. When heated, they are decomposed without explosion. The proportional number of the acid drawn from its combination with baryta is 254.7., for 100 parts of the acid combine with 30.07 of baryta.—*Annales de Chimie*, xxxvii. 160.

29. *Artificial formation of Urea*, by M. Wöhler.—Some time since M Wöhler stated that when cyanogen acted upon liquid ammonia, amongst other products were oxalic acid and a white crystalline substance; the latter appeared to be formed also whenever cyanic acid was combined with ammonia by double decomposition: it is obtained most readily when cyanate of silver is decomposed by muriate of ammonia, or cyanate of lead by pure ammonia: in the latter way a quantity was prepared for experiment, and appeared as colourless, transparent, four-sided rectangular crystals. Nothing but oxide of lead and the particular substance is formed in this process.

Potash or lime evolve no ammonia from this substance, although, supposing it a cyanate of ammonia, that might have been expected; and it is unlike the cyanates in that it does not evolve carbonic and cyanic acids by the action of other acids, nor does it precipitate salts of lead and silver, which would seem to imply that it does not contain either ammonia or cyanic acid.

When nitric acid is added to it, brilliant scaly crystals were formed, which, when purified by crystallization, were very acid; these being neutralized gave nothing but nitrates and the peculiar matter in the state it originally possessed. This peculiar action with nitric acid, induced a comparison of it with urea obtained from urine, when the latter body was found to be identical with the peculiar crystalline substance or cyanate of ammonia, in all the properties attributed to the former body by Proust, Prout, and others. M. Wöhler remarks a circumstance, in addition to those which have been pointed out relative to urea, namely, that when either it or the artificial compound is decomposed by heat, besides a large quantity of carbonate of ammonia, there is produced, towards the end of the operation, the odour of cyanic acid,

resembling that of acetic acid, exactly as in the distillation of the cyanate of mercury, or uric acid, or urate of mercury.

If urea is formed by the union of cyanic acid and ammonia, then the composition of the former ought to agree with that of the latter, as M. Wöhler had formerly given it, supposing the cyanate to contain one atom of water, as all the hydrated ammoniacal salts do. The cyanate of ammonia is composed of 56.92 cyanic acid, 28.14 ammonia and 14.74 of water; so that the ultimate composition of this salt and of urea, as analysed by Dr. Prout, are as follows:

	Cyanate of Ammonia		Urea.	
Azote	4 atoms,	46.78	4 atoms,	46.650
Carbon	2	20.19	2	19.975
Hydrogen	8	6.59	8	6.670
Oxygen	2	26.24	2	26.650
		99.80		99.945

When cyanic acid is decomposed by oxide of copper and heat, it yields 2 volumes of carbonic acid gas, and 1 volume of azote: when the cyanate of ammonia is decomposed in the same way, equal volumes of these gases are obtained; the same ratio of equal volumes was obtained by Prout from urea when decomposed in the same manner.—*Annales de Chimie*, xxxvii. 330.

30. *Identity of Asparagine with Ageodoite.*—Ageodoite is a crystalline substance, remarked by M. Robiquet as accompanying the saccharine principle in the liquorice root, and supposed to be of a peculiar nature. According to M. Plesson it is identical with asparagine. In does not exist in the dry root, but both the dry and the fresh root contain a magnesian salt of which the acid appears to be new and peculiar.—*Annales de Chimie*, xxxvii. 81.

Natural History.

1. *Dependence of Sight upon the Optic Nerves.*—From certain observations made at the Hôtel Dieu, at Paris, M. Majendie is inclined to doubt the absolute necessity of the optic nerves to vision. A case there occurred in which the optic nerves were *gradually* destroyed by a tumor, and yet the man saw objects distinctly a short time before his death. It is admitted, that the sudden division of the optic nerves causes total blindness; but it is stated, that the fifth pair of nerves has an influence over the senses of seeing and hearing, and it is thought possible, that when the optic nerve is gradually destroyed; this pair may, in certain circumstances, supply its place.—*Jour. de Physiologie*, viii. 27.

2. *Innocuous Nature of Putrid Exhalations.*—A committee have been engaged in France in examining the circumstances relative to the knacker's operations. His business consists in killing old worn-out horses, and turning every part of their body to account.

The most singular results which the committee have obtained relate to the innocuous nature of the exhalations arising from the putrefying matter; everybody examined agreed that they were offensive and disgusting, but no one that they were unwholesome; on the contrary, they appeared to conduce to health. All the men, women, and children concerned in the works of this kind had unvarying health, and were remarkably well in appearance, and strong in body. The workmen commonly attained an old age, and were generally free from the usual infirmities which accompany it. Sixty, seventy, and even eighty, were common ages. Persons who live close to the places, or go there daily, share these advantages with the workmen. During the time that an epidemic fever was in full force at two neighbouring places, not one of the workmen in the establishment at Montfaucon was affected by it. It did not appear that it was only the men who were habituated to the works that were thus favoured: for when, from press of business, new workmen were taken on, they did not suffer in health from the exhalations.

In confirmation of the above observations similar cases are quoted: above 200 exhumations are made yearly at Paris, about three or four months after death; not a single case of injury to the workmen has been observed. M. Labarraque has observed, that the catgut makers, who live in a continually putrid atmosphere, arising from macerating intestines, enjoy remarkable health. Similar circumstances were remarked at the exhumations of the Cimetière des Innocens.

Whatever disease the horse may have died of, or been killed for, the workmen have no fear, adopt no precautions, and run no risk. Sometimes, when strangers are present, they pretend to be careful, but, upon close inquiry, laugh at such notions. They handle diseased as well as healthy parts *always with impunity*. They frequently cut themselves, but the wounds heal with the greatest facility, and their best remedy is to put a slice of the flesh about the wound.

On making inquiry of those to whom the horse-skins were sent, and who, besides, having to handle them when very putrescent, were more exposed to effects from diseases in the skin, they learnt that these men, also, from experience, had no fear, and never suffered injury. Horse-skins never occasioned injury to those who worked them, but in this they differed from the skins of oxen, cows, and especially sheep, which sometimes did occasion injury, though not so often as usually supposed.—*Recueil Industriel*, v. 55.

3. *Detection of Blood.*—A difference of opinion has taken place lately in Paris, relative to the efficacy of certain chemical means of ascertaining whether dried spots or stains of matter suspected to be blood, are or were blood, or not. M. Orfila gives various

chemical characters of blood under such circumstances, which he thinks sufficient to enable an accurate discrimination. This opinion is opposed by M. Raspail, who states that all the indications supposed to belong to true blood, may be obtained from linen rags, dipped, not into blood, but into a mixture of white of egg and infusion of madder, and that, therefore, the indications are injurious rather than useful. This is contradicted by M. Orfila, and a commission claimed for the examination of the question. Both disputants agree that the microscope is of no use.—*Med. Journ.* lix. 366.

4. *Globules of the Blood.*—M. Raspail states that the globules of the blood vary in diameter, according to the organs which supply the blood under examination, contrary to the general opinion, which considers their diameter as constant and invariable in every part of all individuals of the same species.—*Med. Journ.* lix. 366.

5. *Growth of Hair.*—A man between twenty and thirty years of age, of strong and healthy constitution, having a short, curly, and coarse hair, of a dark brown colour, found himself becoming bald. Numerous and large bald spots appeared on the head, and gradually increased until it became perfectly bare, and as the eye-lashes fell out, the man had quite a singular and disagreeable appearance. When the head was closely examined, a short, white, and scattered down, very similar to a slight degree of mouldiness, was perceptible. At first it was hoped that the hair would grow again, but the sequel proved the contrary; after two years Dr. Radmacher advised him to pour French brandy upon sulphate of copper, and, when it had remained a few days, to wash the bald parts once a day with the solution. In eight days the hair had begun to grow, and in four months it equalled the original growth in quantity, but was of a lighter colour, crisp, dry, and stiff, and had not a natural appearance. A spot still remained bald on the back of the head. The eye-brows and lashes grew again like the rest of the hair. A year after this, the man shed his hair again, but the eye-brows and lashes remained. Dr. R. wished him now to wait awhile, to ascertain whether the hair would or would not grow again spontaneously, but the patient would not, and had recourse to the solution, which produced another growth of bland or light hair, and the spot, which before had continued bald, notwithstanding the solution, became covered in common with the other parts of the head. This growth had a much more natural appearance than the former one.—*Med. Journ.* lix. 470.

6. *Stammering.*—According to Dr. Mac Cormach stammering arises from an attempt to speak when the lungs are nearly empty, or when the stammerer is drawing in his breath. To cure this habit, he makes the stammerer take a deep inspiration, and repeat

with the whole force of the expiration the different letters of the alphabet, numerals, and monosyllables, *one by one.* This may be prefaced or not by several hours' practice of deep and slow breathing. This practice is to be continued for hours, days, or weeks, according to the inveteracy of the habit; and then polysyllables are to be pronounced during one expiration; then short sentences, and ultimately long sentences. Thus, reversing the evil habit, a new habit is acquired, and the cure effected. In general, a few days, or at most weeks, will be sufficient.—*Med. Rep.* N. S. vi. 571.

7. *Communication of Disease by Leeches.*—In a journal entitled the "Westphaelischer Anzeiger," a case is recorded where some leeches, which had been employed first on a syphilitic patient and afterwards on an infant, communicated the disease to the latter. This warns us not to apply leeches to a second person without having sufficient assurance that the previous affection of the first patient was not infectious.—*Med. Rep.* vi. 477.

8. *Preservation of Leeches.*—A new vessel of deal large enough to contain sufficient water for five hundred leeches is to be furnished with a stop-cock to draw off the water. It is to be half filled with the mud from the lake or pond whence the leeches have been taken, and two or three roots of the Florence Iris (*Calamus Aromaticus*) are to be set in the mud. The leeches like this plant. The usual precautions as to temperature, frequent change of water, &c. are to be taken; the water is to be changed slowly, and the fresh water added by means of a funnel descending to the bottom of the vessel. This method has been found preferable to all others tried at the hospital of Bamberg.—*Bull. Univ.* cxiii. 369.

9. *St. Helena Silk.*—A specimen of raw silk produced in the island of St. Helena, has arrived in England. It is the first perfect one, and is considered as being of very fine quality. It is entirely free from any disagreeable odour, which is much in its favour. In last August the number of worms in progress was 218,000, which were in a very healthy condition, and expected to spin in a few days. The mulberry trees thrive well and have a very luxuriant appearance.

10. *Migration of Butterflies.*—Madame de Meurin Wolff, being in the country with her family, in the district of Grandson in the Canton de Vaud, perceived, on the 8th or 10th of June, 1826, an enormous quantity of butterflies (*Papilio Cardui*, L.) traversing the garden with great rapidity: they all proceeded in the same direction from south to north, not deviating to the right or left, flying close to each other, and not being disturbed by human beings. This continued for at least two hours; the insects did not

stop on the flowers, their flight was low and uniform; the width of the column was about ten or fifteen feet.

Borrelli at Turin observed a similar circumstance with the same butterfly, at the end of March in the same year. They also flew from south to north; the air was filled in the places where flowers abounded, and at night the plants were covered; their number diminished after the 29th of March, but some continued to appear until June. M. Huber, who describes these and similar appearances (which are not uncommon,) supposes that the portion seen in Switzerland may have been a part of the column which passed over Turin.

The caterpillars of these butterflies do not live in society, and are isolated from the time they leave the eggs.—*Mém. de Genève*, iii. 247.

11. *Nature of those Gelatinous Substances supposed to fall from the Atmosphere.*—One of these gelatinous masses, which being found in meadows are often supposed to have fallen from the atmosphere, was taken to Dr. Brandes, who examined and made out its nature with considerable certainty. It equalled about 2½ cubical inches, was white, and resembled swelled tragacanth; it was covered in several places with a fine skin, which had burst here and there, and allowed a bulky gelatinous mass to protrude. The bursting had occurred from swelling caused by the absorption of moisture. Where entire, it showed a vermicular appearance, of the thickness of a quill, having the figure of an intestine. The back was marked by a tender vessel of a dark brown colour. In a dry place the substance shrunk, became yellowish brown and tough, like glue, and at last horny; 20 grains were reduced to 4 grains by desiccation. Being moistened with water, it swelled up to its former size and colour. 100 grains boiled in 3 ounces of water converted the whole into a tremulous mass when cold. 100 parts gave 18.8 of gelatinous substance, 1.2 phosphate of lime and phosphate of soda, and 80 of water,

This substance Dr. Brandes concludes to have been the spawn of a *limax rufus*, or some other species of *limax*, swelled by water; and the supposition was confirmed. on finding, in a portion of the substance placed in a cup for a few days, a little naked snail, (*limax*) about a quarter of an inch long. The spawn, although small at first, swells by moisture, and hence the reason why these substances are usually found in meadows and moist situations. M. Brandes then considers and reconciles the observations of MM. Buchner and Schwabe with those of his own.—*Phil. Mag.* N. S. iii. 271.

12. *Ancient Olives and Oil discovered at Pompeii.*—Mr. Ramage, speaking of discoveries at Pompeii, says, "the most curious discovery of all is, that of two glass vases, one of which contained olives, with the oil in which they had been placed eighteen

centuries before, and the other nothing but pure oil." They were examined by Professor Correlli of Naples. The olives were in a quadrangular glass vessel with a large mouth, the upper half was filled with ashes and pebbles, the lower half contained the fruit mingled with a buttery substance; they have the form and size of those called *Spanish Olives;* some still retain the stalk; their colour is black, but mixed with small greenish particles, which by a microscope proved to be one of those lichens, produced on vegetable matter during putrefaction, and which there was every reason to suppose only occurred after the olives had been exposed to the air. The olives are soft, pulpy, have a strong rancid smell, a greasy taste, and leave an astringent, sharp sensation upon the tongue. They swim on water; the seed-vessel shows its organic texture, the parenchyma does not; the kernels are hard, but penetrable by a knife. The oily part of the parenchyma, when analysed, was found changed into oleic and margaric acid.

The substance in which the olives were involved is of a brown yellow colour, soft, like butter, has a strong, rancid smell, stains paper like fat, melts at a moderate heat, (60° or 70° C. ?), burns with a bright flame. It is composed of oleic acid in large quantities, a small portion of margaric acid, a substance analogous to the sweet principle of fixed oils, and a small quantity of ashes.

The oily substance was found separately in a cylindrical glass vase with a narrow neck, and a small handle. It was softer than the preceding, had a yellowish green colour, a strong rancid smell, and exhibited in the mass a number of brown globules, similar to the spawn of fish, the nature of which could not be distinguished by a powerful microscope. Chemically, this substance resembled that found with the olives, and appears to have been nothing else than olive oil.—*Jameson's Journal,* 1828, p. 248.

13. *Effect of Electricity on pointed Leaves, &c. and on Vegetation.*—For the double purpose of ascertaining the power of spines and sharp-pointed lanceolated leaves in modifying the electric relation of the atmosphere and the earth, and in affecting the progress of vegetation by their electric influence, M. Astier insulated a sextuple spine of the *Gleditzia triacanthos* at the top of his house, and brought a wire down from it to an insulated flower-pot, in which were planted five grains of maize; a similar sowing was made in an uninsulated pot, for the purpose of comparison. The experiment continued from the 6th to the 20th of June, including two stormy days. The electrometer gave considerable signs of electricity in the flower-pot, and by using the condenser sparks were produced. The electrified grains were found to pass more rapidly through the first periods of vegetation. When Bengal rose-trees were submitted to the same experiment, the flowers of the electrified plant appeared more rapidly and more abundant than in the other case.—*Ann. Linn. de Paris.*

14. *Echites Suberecta or Savana Flower of Jamaica.*—Mr. Sells has published an account of this plant and its poisonous effects, principally from his own knowledge, with a view to the more perfect history of the plants in the East Indies affording the poisonous "Upas tieute" and "Tshittik," and those of South America yielding "Ticunas" and "Woorara:" one or more of these poisons he thinks is derived from the above plant.

The Echites suberecta is of the class pentandria, order monogynia, the natural order Contortae of Linnæus, or Apocinea of Jussieu. *Generic characters,—calyx,* perianth small; deeply five cleft, acute. *Corolla* of one petal, funnel-shaped, pervious; limb, five cleft, flat, widely spreading. *Nectary,* five glands, placed round the germens. *Stamens,* filaments five, slender, erect; anthers rigid, oblong, pointed, converging. *Pistils,* germens two; style single, thread-shaped, the length of the stamens; stigma, oblong capitate, two-lobed, connected with the anthers by a viscid juice. *Pericarp,* follicles two, very long, each of one cell and one valve; seeds numerous, imbricated, crowned with long down, and affixed to a linear receptacle.

The habit of echites is climbing, not only being found in savanas, but growing commonly in the live fences, creeping over them, winding round trees to a height of 15 or 20 feet. The flowers of the species suberecta are of a bright yellow, and resemble in shape that of the convolvulus; the seed-vessels are from 5 to 10 inches in length, slender and somewhat curved; the leaves are of a dark green and very shining, the plant abounds with an acrid milky juice.

With regard to the poisonous powers of this plant, it appears that 2 drachms of the expressed juice killed a dog in eight minutes. Some of the vine of this flower being thrown carelessly into a horse-trough when dry, rain afterwards fell, the trough filled, and mules drinking of the water, a great many were destroyed. A jug of rum having had its mouth stopped with a handful of the leaves, two of the men who afterwards drank of the spirit died. In the green state, animals never touch it; but when cut with the grass and dried, animals eat it sometimes, and are then killed by it. Some negroes endeavoured to poison an overseer by putting a portion of the powdered roots into some water intended for drinking, but the intention was discovered and some of the powdered root found. After exposure to rain and air, being examined, 4 grains given to a dog made it very ill, but the animal recovered; 6 grains of the recently powdered root killed the dog in less than three hours.—*Med. Repos.* vi. 301.

15. *Height of Mont Blanc.*—The height of Mont Blanc and of the Lake of Geneva has lately been carefully ascertained by M. Roger, an officer of engineers in the service of the Swiss Confederation. The summit of the mountain appears to be 4435 metres,

or 14.542 English feet above the lake of Geneva, and the surface of the lake 367 metres, or 1233 English feet above the sea. The mountain is, therefore, 15,775 feet above the level of the sea.—*N. M. Mag.* xxiv. 263.

16. *Water Spout.*—At 52′ after 6 o'clock on the 11th of August last, a portion of a dark cloud, suspended below the summit of the Savoy mountains, suddenly took a vertical direction, and, being gilded with the deep orange tint of the setting sun, attracted universal attention, and enabled the spectators to trace all its movements. Its form was that of an inverted cone, the summit of which was about 200 feet above the surface of the lake, to which it precipitated itself in less than two minutes. This elongation of the cone took place by an oscillatory motion. This part of the spout appeared cylindrical, and its diameter was about 10 or 12 feet. The moment it reached the lake, a great mass of the water was briskly agitated, as if it had been boiling, the foam rising to a height of more than 50 feet. This large column of water was inflected like a ribband exposed to the wind. In eight minutes it reached the mouth of the Rhone, and as long as it was above the river the boiling continued and the column was unbroken. When it quitted the river, the boiling ceased and the whole soon disappeared, the base of the cone continuing longest visible.—*Mon. Mag.* v. 540.

METEOROLOGICAL DIARY for the Months of March, April, and May, 1828, kept at Earl Spencer's Seat at Althorp, in Northamptonshire.

The Thermometer hangs in a North-eastern Aspect, about five feet from the ground, and a foot from the wall.

For MARCH, 1828.

		Thermometer.		Barometer.		Wind.	
		Lowest.	Highest	Morn	Eve	Morn.	Eve.
Saturday ..	1	43	50	30 08	29 99	NW	NW
Sunday	2	43	48	29 90	29 90	NW	NW
Monday....	3	35	48	29.88	29.70	W	WbN
Tuesday ...	4	34	50	29.76	29.66	W	WNW
Wednesday.	5	36	42	29 50	29 53	WNW	NW
Thursday ..	6	26½	39	29.70	29 83	NW	NNW
Friday	7	25	42	30.00	29.97	W	W
Saturday...	8	36½	57	29 84	29 97	W	WbS
Sunday	9	40	56	30.00	30 00	W	W
Monday....	10	41	57	30 00	30 00	WSW	W
Tuesday ..	11	43	57	30 00	30 00	W	W
Wednesday.	12	41	51	29.90	29 87	SW	SE
Thursday ..	13	40	57	29 87	29.99	W	W
Friday.....	14	40	57½	30 02	29 97	SW	W
Saturday...	15	39	60½	30.12	30 19	W	NW
Sunday	16	38	62	30.13	30 02	WSW	WbS
Monday....	17	48	58	30 00	30.00	W	W
Tuesday ...	18	43	55	30.00	29 73	NW	SW
Wednesday.	19	43	51	29 30	29.33	WbS	NW
Thursday ..	20	37	51	29 30	29 09	W	SW
Friday	21	35	54	29 00	28 88	SW	SW
Saturday...	22	33	49	29.01	29.09	W	WbS
Sunday	23	31	47	29 23	29 30	WNW	W
Monday ...	24	30	47	29.47	29.57	W	NW
Tuesday ...	25	32	46	29.62	29 70	N	NE
Wednesday.	26	25	47	29 70	29 64	NE	EbS
Thursday ..	27	33	53	29 39	29.30	E	E
Friday.....	28	38	46	29 30	29 50	NE	NE
Saturday ..	29	32	47	29.60	29 64	W	N
Sunday	30	32	48	29 80	29.90	E	NE
Monday ...	31	27	53	30.04	30.10	NE	SE

For APRIL, 1828.

		Thermometer		Barometer.		Wind.	
		Lowest.	Highest	Morn.	Eve.	Morn	Eve.
Tuesday ...	1	34	54	30.10	30.01	SE	SbE
Wednesday.	2	36	49	29 90	29 90	SE	NE
Thursday .	3	31	45½	29 97	29 85	NW	NW
Friday	4	34	45	29.79	29 78	N	NbW
Saturday...	5	27½	53	29.68	29 58	W	NW
Sunday	6	32	47	29 40	29 43	NW	NE
Monday ...	7	35	46	29.30	29 27	E	NE
Tuesday ...	8	35	47	29.27	29 14	E	E
Wednesday.	9	37	44	29 10	29 23	NE	WbS
Thursday ..	10	37	57	29.26	29 32	SW	WNW
Friday.....	11	36½	57	29.50	29.59	WSW	SW
Saturday ..	12	41	63	29.46	29 41	SW	SE
Sunday	13	40	58	29.30	29 30	SSW	SW
Monday ..	14	40	59	29 51	29 60	WbS	WbS
Tuesday ...	15	42	57	29 62	29 42	SW	SW
Wednesday.	16	43	53	29.44	29 18	SW	SSE
Thursday ..	17	43	58	29.18	29 20	SW	SE
Friday	18	46	57	29.20	29.39	E	NW
Saturday...	19	45	54½	29.38	29.50	N	NNE
Sunday	20	45	52	29 73	29.73	NE	NE
Monday ...	21	43	48	29 65	29 51	NE	NNW
Tuesday ...	22	39	51	29.50	29.50	WbN	SW
Wednesday.	23	39	56	29 55	29 60	W	SW
Thursday ..	24	44	60	29 54	29 66	SW	WbS
Friday	25	44	56	29 66	29.56	SW	WSW
Saturday...	26	40	60	29 61	29 88	W	WbS
Sunday	27	32	59	30.08	30.08	S	SW
Monday....	28	45	68	30 08	30 08	SW	W
Tuesday ...	29	46½	72	30 08	30.00	SSW	SW
Wednesday.	30	51	64	30.10	30.18	NW	NW

For MAY, 1828.

		Thermometer.		Barometer.		Wind.	
		Lowest.	Highest	Morn.	Eve.	Morn.	Eve.
Thursday ..	1	37	53	30.18	30.18	N	NNE
Friday	2	36	59	30.12	30.00	ENE	ENE
Saturday...	3	43	59	29.89	29.83	E	SE
Sunday	4	47	62	29 67	29 57	W	WNW
Monday....	5	45	60½	29 57	29.57	WNW	W
Tuesday ...	6	38	59	29.57	29.57	WbS	NE
Wednesday.	7	39	59½	29 64	29 68	NE	NE
Thursday ..	8	45	58	29 73	29.78	N	NW
Friday.....	9	47	60	29.80	29.90	NW	WNW
Saturday...	10	37	58	29 93	29 93	SW	WSW
Sunday	11	40	67	29 90	29.90	SW	SW
Monday. ..	12	42	63	30 00	30 07	WNW	E
Tuesday ...	13	39	67	30 09	30 07	SW	W
Wednesday.	14	46	66	30 05	30 00	N	ENE
Thursday ..	15	42	68	29.94	29 96	ENE	E
Friday.....	16	48	68	29.80	29 74	E	E
Saturday...	17	49½	66	29 74	28.70	ENE	ENE
Sunday	18	51	63	29 70	29.70	ENE	E
Monday....	19	43	56	29.70	29.70	E	E
Tuesday ...	20	42	63	29 68	29.60	EbN	SE
Wednesday.	21	45	61	29.52	29.46	E	E
Thursday ..	22	47	58	29.46	29 46	NE	SE
Friday	23	47	64	29.46	29.46	NE	NE
Saturday...	24	49	67	29.38	29.22	ESE	SE
Sunday	25	54	66	29 41	29.60	WbS	WbS
Monday....	26	47	68	29.63	29.48	S	[illegible]
Tuesday ...	27	50	68	29 48	29 40	SbE	E
Wednesday.	28	45	66	29.33	29 42	E	SW
Thursday .	29	53	69	29.46	29 50	S	SW
Friday.....	30	43	70½	29.70	29 73	NW	W
Saturday ..	31	53	71	29 66	29.64	SW	W

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Instead of *April to July*, which occurs in most of the sheets of the present, [illegible] read *April to June.*

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